Don Scott

TM 11-1258

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

SG-3

SIGNAL GENERATOR

AN/URM-70

DEPARTMENT OF THE ARMY • JULY 1955

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 400-volt power supply circuit and on the 115-volt ac line.

ROADWAY EXPRESS, INC.
DEDICATED TO BETTER SERVICE

1 %

50 = 49.5 — 50.5
100 = 99 — 101
200 = 198 — 202
400 = 396 — 404

Drift .03 %
per 1/2 hr

300 = 299.91
300.09

TECHNICAL MANUAL
No. 11–1258

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *6 July 1955*

SIGNAL GENERATOR AN/URM–70

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual covers Signal Generator AN/URM–70 (fig. 1). Instructions are given for its installation, operation, repair, and maintenance. In addition to these instructions, there is a chapter devoted to its circuit theory.

b. All comments on this manual will be forwarded direct to Commanding Officer, Signal Corps Publications Agency, Fort Monmouth, N. J. ATTN: Standards Division.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and when performing preventive maintenance:

a. DD Form 6 (Report of Damaged or Improper Shipment) will be filled out and forwarded as prescribed in SR 745–45–5 (Army); Navy Shipping Guide, Article 1850–4 (Navy); and AFR 71–4 (Air Force).

b. DA Form 468 (Unsatisfactory Equipment Report) will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. DD Form 535 (Unsatisfactory Report) will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in AF TO 00–35D–54.

d. DA Form 11–238 (Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar)) will be prepared in accordance with instructions on the back of the form (fig. 6).

e. DA Form 11–239 (Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar)) will be prepared in accordance with instructions on the back of the form (fig. 7).

f. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Signal Generator AN/URM–70 is designed to provide very-high frequency (vhf) test signals for field or laboratory measurements, testing, and alinement. The signal generator is intended primarily for use as test and maintenance apparatus for Radio Sets AN/TRC–24, AN/TRQ–2, AN/GRC–10, AN/TRC–8, and AN/TRC–1.

b. Signal Generator AN/URM–70 consists of a Signal Generator SG–3/U in a shock-mounted carrying case (Transit Case CY–1504/URM–70) along with accessories and spare parts (fig. 2). In field installations, the signal generator can remain in its carrying case, which provides adequate shock mounting. All cables, controls, and connections are available at the front panel when the transit case cover is removed. Front-panel louvers provide ventilation for the signal generator chassis. When used indoors, the instrument may be taken out of the transit case.

c. The signal generator provides a radio-frequency (rf) test signal variable between 50 and 400 megacycles (mc) in three bands. The output signal can be frequency-modulated (fm) by an external source or by the internal audio oscillator. The internal source provides three different modulating frequencies: 1,000 cycles, 1,600 cycles, or 20,000 cycles. The maximum frequency deviation produced by the internal modulator is 150 kilocycles (kc) for an rf output between 50 and 100 mc; 300 kc for an rf output between 100 and 200 mc; and 600 kc for an rf output between 200 and 400 mc.

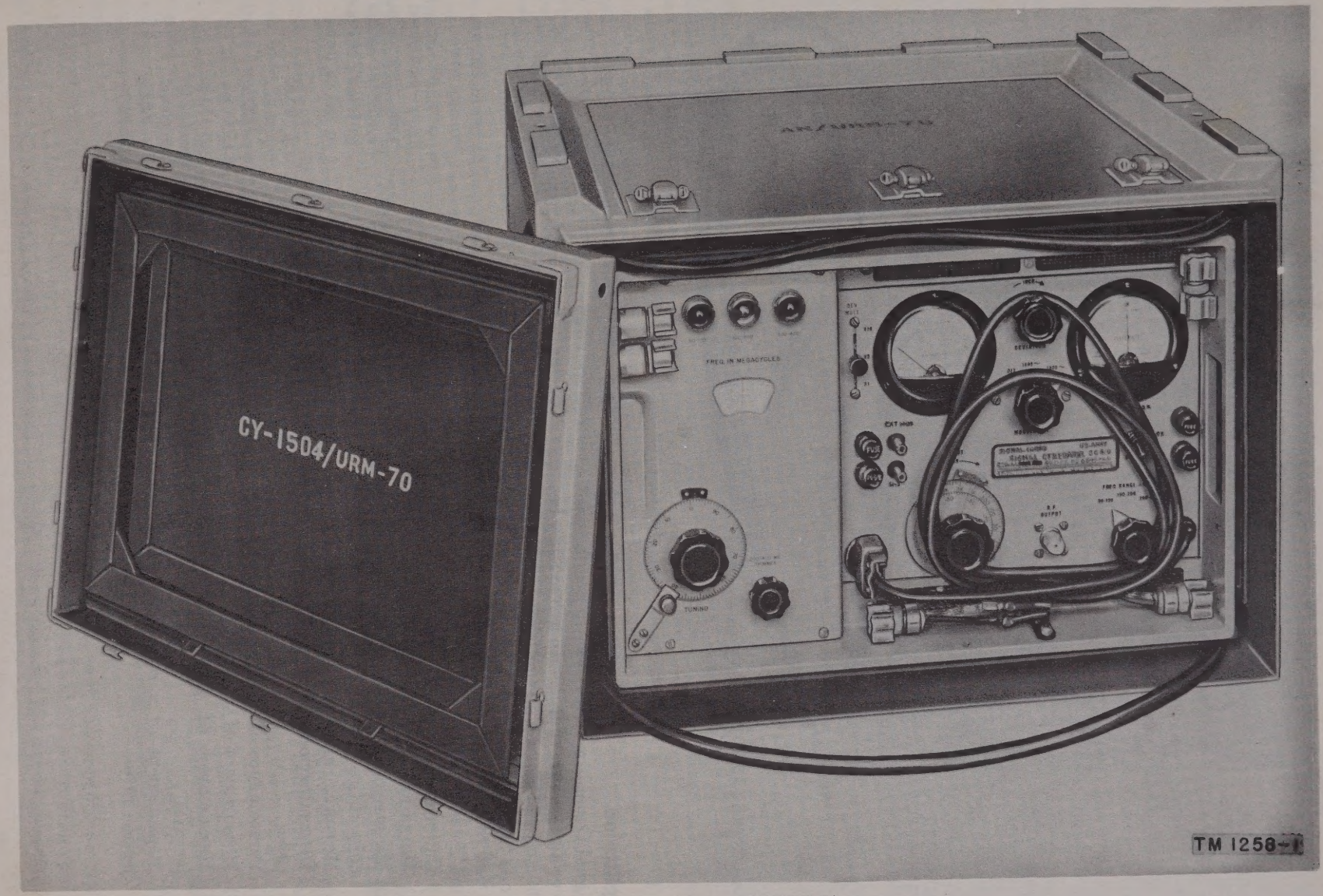


Figure 1. Signal Generator AN/URM–70.

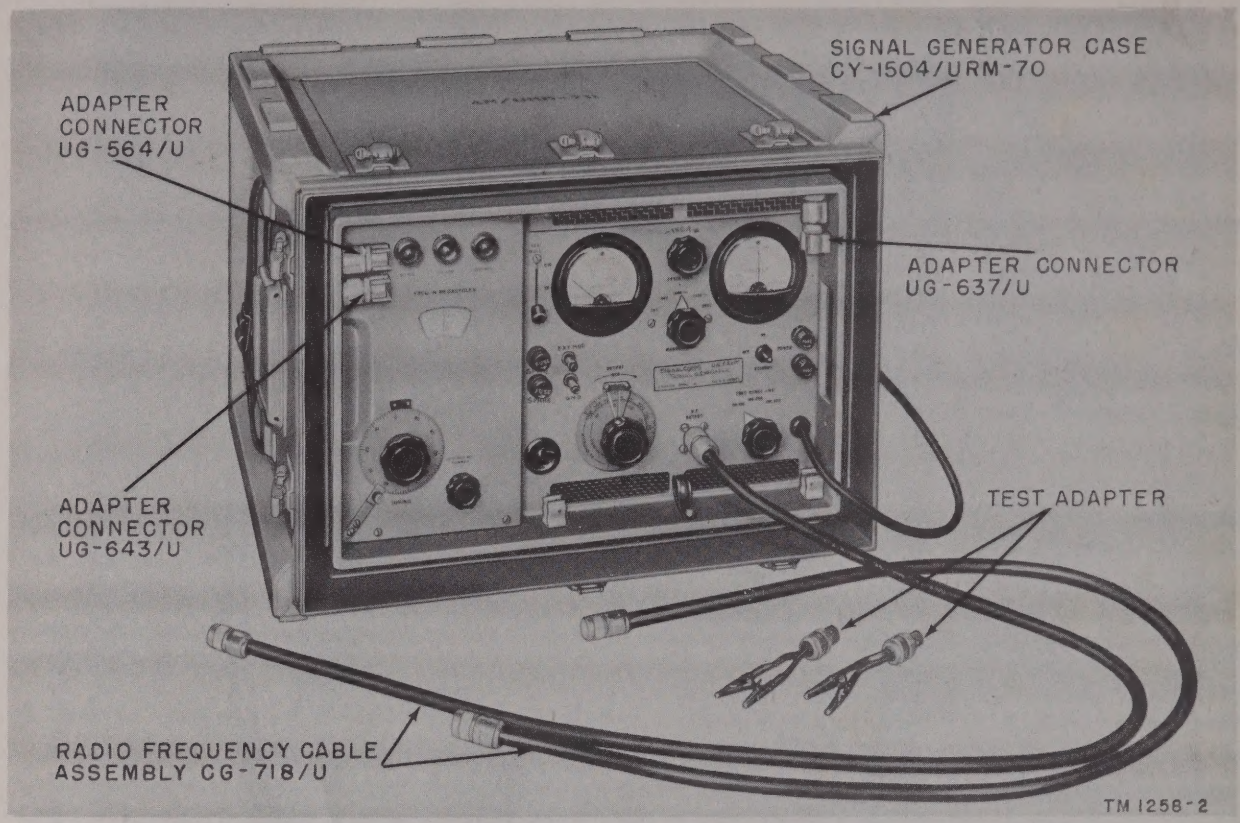


Figure 2. Signal Generator AN/URM–70, with cables and adapters.

4. Application

a. Signal Generator AN/URM–70 may be used whenever an rf signal source with a frequency between 50 and 400 mc at a strength of .1 to 100,000 microvolts is required.

b. A few of the applications of the signal generator are listed below:

(1) Calibration of oscillators.
(2) Measurement of receiver sensitivity.
(3) Measurement of signal plus noise-to-noise ratio.
(4) Measurement of overall distortion.
(5) Determination of band-pass characteristics.
(6) Performance of alinement procedures.
(7) Measurement of stage gain.
(8) Measurement of discriminator characteristics.
(9) Measurement of a receiver's image rejection ratio.

5. Technical Characteristics

Frequency range:	
Band A	50 mc to 100 mc.
Band B	100 mc to 200 mc.
Band C	200 mc to 400 mc.
Types of output:	
Unmodulated rf	50 mc to 400 mc, continuous wave.
Frequency-modulated rf	50 mc to 400 mc; internally modulated at 1,000, 1,600, or 20,000 cycles per second, or externally modulated at 250 to 70 kc.
Fm frequency deviation:	
Band A	0 to 15 kc.
	0 to 75 kc.
	0 to 150 kc.
Band B	0 to 30 kc.
	0 to 150 kc.
	0 to 300 kc.
Band C	0 to 60 kc.
	0 to 300 kc.
	0 to 600 kc.

Type of internal modulation	fm.
Input power requirements	115 volts ac ±10 percent. 50 to 60 cycles. 125 watts.
Output signal level	.1 to 100,000 microvolts (max.).
Output voltage accuracy	±25 percent.
Modulation distortion:	
DEV MULT in X5, meter reading full scale	.5 percent.
DEV MULT in X10, meter reading full scale	5 percent.
Frequency stability after 2-hour warmup	±.03 percent per half hour.
Spurious fm below rated deviation	55 db.
Deviation accuracy	±25 percent.
Maximum spurious am	15 percent.
Rf harmonic distortion	3 percent.
Rf subharmonic distortion	10 percent.
Maximum voltage standing wave ratio of output impedance	1.5 percent.
Number of vacuum tubes	17.
Output impedance	50 ohms.
Dial calibration accuracy	±1.0 percent.
Weight	72 lb.

6. Packaging Data

(fig. 3)

When packaged for shipment, Signal Generator AN/URM–70 and two manuals are packed in a wooden crate. The crate is 22½ inches high, 26 inches wide, 19 inches deep, and has a volume of 6.3 cubic feet. Within the wooden crate, the signal generator is protected from shock by a separate carton and cardboard cells. Manuals are wrapped individually and sealed in moistureproof bags. The total weight of the sealed crate is 160 pounds. Cases for export shipment are strapped with metal bands.

7. Components

The following chart lists the physical dimensions of the components for this equipment.

Component	No. required	Height (in.)	Depth (in.)	Width (in.)	Length (in.)	Volume (cu. ft.)	Unit weight (lb.)
Signal Generator SG–3/U	1	14⅞	11 3/16	17¼			72
Transit Case CY–1504/URM–70	1	18 1/32	14 15/16	20⅝			33
Test adapter (terminated in 51-ohm shunt)	1				5½		
Test Adapter (unterminated)	1				5½		
Adapter Connector UG–643/U	1						
Adapter Connector UG–564/U	1						
Adapter Connector UG–637/U	1						
Radio Frequency Cable Assembly CG–718/U	2				48		
Manual	2						
Total							105

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

8. Description of Signal Generator AN/URM–70

a. Signal Generator AN/URM–70 consists of Signal Generator SG–3/U shock-mounted in a transit case (fig. 1). All cables, connections, and controls required are available at the front panel (fig. 2) of the signal generator. The two front-panel meters are an output level meter and an fm deviation meter. The signal generator contains a 17-tube circuit that provides an fm or continuous-wave (cw) test signal within the range of 50 to 400 mc. The front-panel indicator lamps indicate the rf frequency ranges, green, 50–100 mc; amber, 100–200 mc; and blue, 200–400 mc. The FREQ. RANGE-MC selector determines the rf band used. All three scales of the rf dial are calibrated directly in megacycles, and indicate the signal generator output frequency. The output signal strength is variable and is adjusted by using the OUTPUT control, which is calibrated directly in microvolts and decibels referred to 1 milliwatt (dbm).

b. The power line cord, line fuses, and switch are mounted on the front panel for convenience. Clips are provided on the panel to secure the adapter fittings and test adapters when the unit is in transit or storage.

c. All controls and instruments on the front panel are protected by the protruding edge of the panel. This permits the signal generator to be

turned face down for repair or adjustment. Slots in the sides of this projection are used as grips for removing the signal generator from the transit case.

d. Terminals and connectors available at the front panel are an R. F. OUTPUT receptacle, EXT. MOD. and GND binding posts, and an unmarked standard alternating current (ac) receptacle that provides storage for the power-cord plug during transit.

9. Description of Cables and Connectors

(fig. 2)

The cables and connectors included with Signal Generator AN/URM–70 are listed below:

a. Two Radio Frequency Cable Assemblies CG–718/U terminated at each end with Plug Connector UG–573/U.

b. Three Adapter Connectors UG–643/U, UG–564/U, and UG–637/U are used for interconnecting equipments.

c. An unterminated test adapter consisting of Connector Plug UG–572/U and two alligator clips.

d. A test adapter terminated in a resistance of 51 ohms consisting of Connector Plug UG–572/U and two alligator clips.

10. Running Spares

A group of running spares is supplied with Signal Generator AN/URM–70. Two spare fuses are mounted on the front panel of the instrument. Ten additional spare fuses and two spare indicator lamps are mounted inside the instrument case. Spare tubes are mounted on the spare tube chassis (fig. 19). A spare ballast lamp is mounted on the audio-oscillator chassis. The following is a list of the running spares:

4 tubes, type 5654.
1 tube, type 6005.
1 tube, type 6080 WA.
1 tube, type 0A2 WA.
1 tube, type 5751.
1 tube, type 5R4 WGA.
12 fuses, 1.5 amp, slow-blow.
1 lamp, 3S6–120 volt.
2 lamps, 12 volts, #53.

11. Additional Equipment Required

In most tests made with Signal Generator AN/URM–70, additional test equipment will be necessary to indicate gain, correct alinement, or bandwidth of circuits. Various test applications may differ; therefore, it will be a matter of choosing the equipment best suited for the job. In general, the following test equipment may be used for the listed test.

Type of test	Additional equipment
Alinement (cw signal)	Rf or dc vacuum-tube voltmeter or microammeter.
Alinement (fm signal)	Oscilloscope with suitable time base. Audio oscillator.
Stage gain (cw signal)	Rf vtvm.
Overall gain	Vtvm.
Bandwidth (fm signal)	Oscilloscope with suitable time base. Audio oscillator.
Rf distortion test	Fm receiver and a spectrum analyzer.
Bandwidth (cw signal)	Vtvm.
Image rejection ratio	Vtvm.
Signal plus noise-to-noise ratio.	Vtvm.

CHAPTER 2

INSTALLATION

12. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 15.

a. General. Equipment may be shipped in oversea packing cases, domestic packing cases and, sometimes, in its own carrying cases. When new equipment is received, select a location where the equipment can be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment. The instructions in *b* below apply to equipment shipped in export packing cases, and the instructions in *d* below apply to equipment in domestic packing cases. Aside from checking to make sure that all carrying cases are present and that the equipment is undamaged, special unpacking and uncrating procedures are not necessary for equipment shipped in carrying cases.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged or exposed, a complete overhaul might be required or the equipment might be rendered useless.

b. Unpacking (fig. 3).

(1) Unpack the equipment as near the operating position as is convenient.

(2) Cut and fold back the metal straps that encircle the wooden crate; use a pair of tin snips or a large pair of diagonal cutting pliers.

(3) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.

(4) Remove the top pad and the two manuals which are inclosed in waterproof bags.

(5) Open the carton and remove the padding from around the transit case.

(6) Lift the transit case out of the carton.

(7) Open the transit case and remove the panel protecting pad.

(8) The unpacking procedure is now complete, and the signal generator is ready for a thorough delivery check.

c. Checking. Before operating the signal generator for the first time, check the equipment for possible shipping damage.

(1) To make an exterior check, remove the generator from the transit case and check the front panel for bent case, loose knobs, broken meter face, and bent controls.

(2) To make an interior check, remove the left cover panel by unscrewing the six screws on the left side of the generator. This permits removal of the top and bottom sliding panels. Check the interior for broken or misplaced tubes, bent shafts, and loose wiring (fig. 4).

(3) When the checks are completed, replace the cover panels and return the generator to its transit case.

d. Unpacking Domestic Packing Cases. Test equipment may be received in domestic packing cases. The instructions given in *a* above also apply to unpacking domestic shipments. Cut the metal bands. Open the cartons that protect the equipment; if heavy wrapping paper has been used, remove it carefully and take out the components. Check the contents of the packing case against the master packing slip.

13. Placement of Equipment

a. Place Signal Generator AN/URM–70 within 6 feet of a power receptacle or use an extension cord. All control operations and connections are made at the front panel; therefore, the signal generator may be placed directly against a wall, partition, or another piece of equipment. If the temperature of the surrounding air is above 95° F., the instrument must be operated outside the transit case, and with adequate ventilation of the sides, back, and top. If possible, place the generator above and behind the unit being worked on.

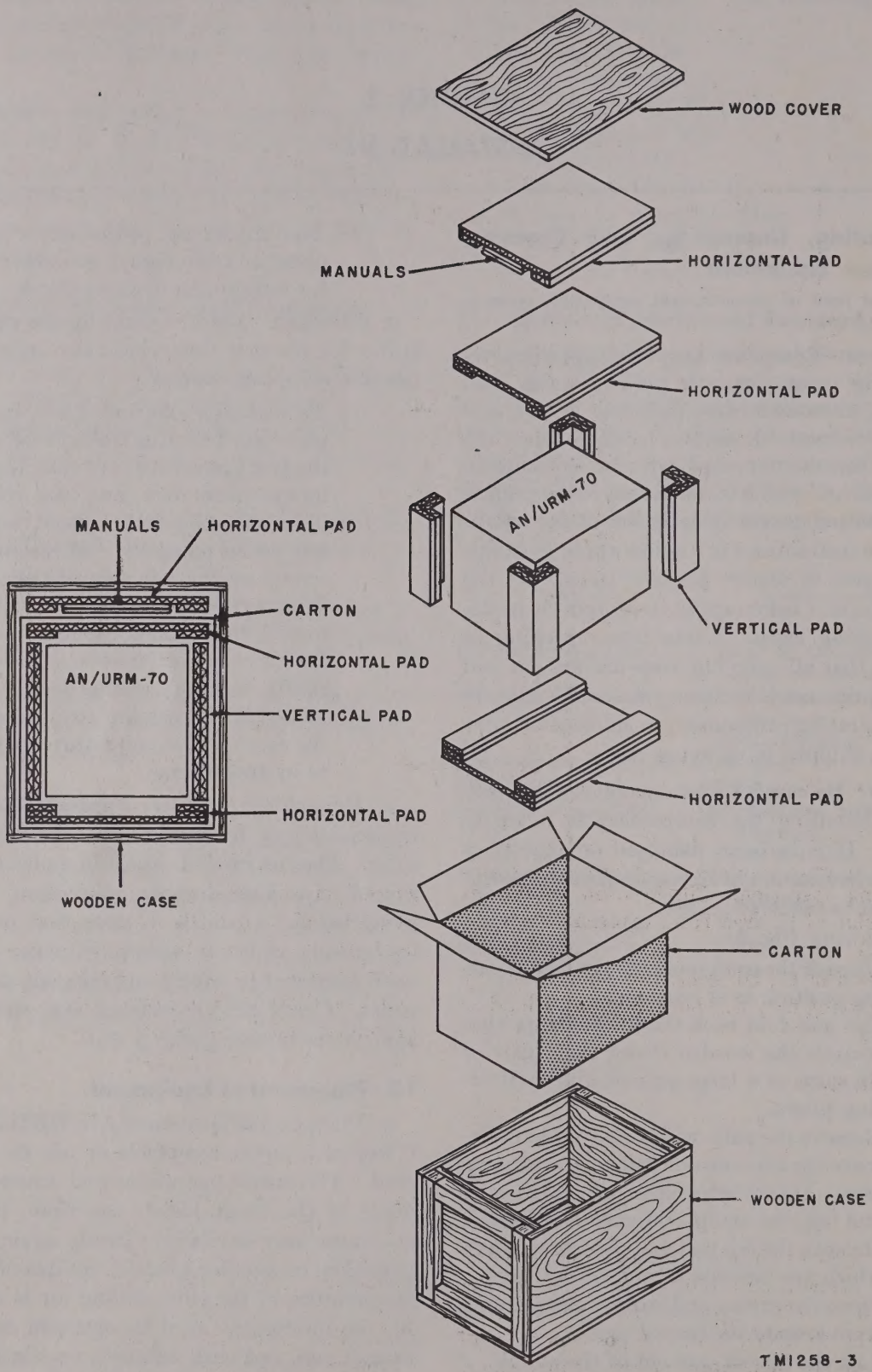


Figure 3. Typical packaging of Signal Generator AN/URM-70.

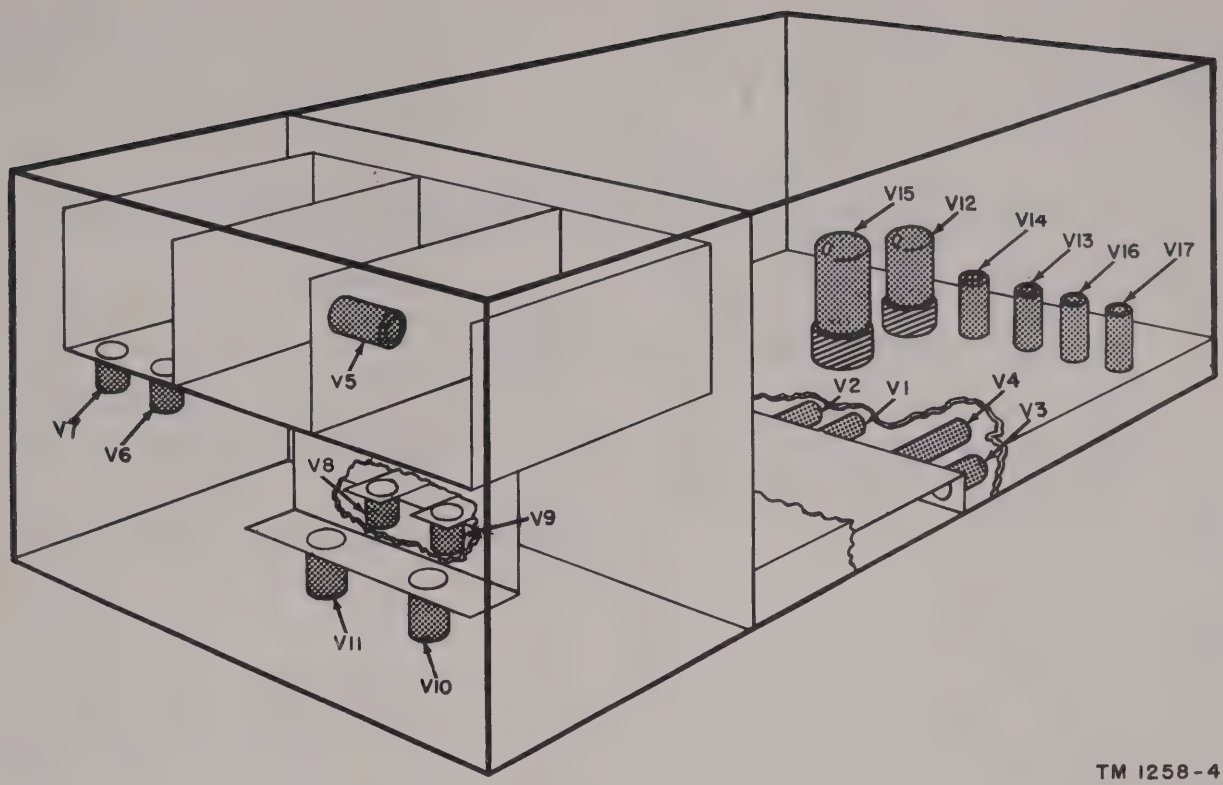


Figure 4. Signal Generator AN/URM–70, tube location.

This provides space for tools and for movement of the unit under test. The signal generator should be positioned close enough to permit use of the test cables supplied. In all cases, the support used for the signal generator must be free from vibration, which could cause microphonics and noise during operation. The location for the instrument should be free from external electrical interference.

b. Locate the signal generator so that its rf radiation during tests will not interfere with other equipment.

14. Connections

After the signal generator is installed in the operating position, connections can be made for testing.

a. Power Connection. Determine the local power source voltage and frequency. The signal generator requires an input voltage source of 115 volts ±10 percent, 50 to 60 cycles. Connect the power cord to this source. Place the POWER switch in the STANDBY or ON position to energize the signal generator power transformer. Lighting of the 50–100, 100–200, or the 200–400 indicator lamp will indicate that the signal generator is energized. Rotate the FREQ. RANGE-MC selector through its three positions. A different indicator lamp will light for each position.

b. External Audio Modulator Connection. It is not necessary to use an external audio oscillator unless a modulation frequency other than 1,000 cycles per second (cps), 1,600 cps, or 20 kc is desired. If an external audio oscillator is to be used, the input terminals marked EXT. MOD. must be connected to the output of the external audio oscillator. The lower terminal (GND) is grounded and is to be connected to the ground terminal of the audio generator. Connection by means of twisted leads or a shielded cable is preferred, especially if the local electrical interference is great or if long lengths of wire are necessary. Any hum or noise picked up from these input leads will be reproduced at the signal generator output.

c. Rf Output Connections. The adapters and connectors listed in paragraph 9 are used to provide various output connections. They include Radio Frequency Cable Assembly CG–718/U, two adapters with alligator clips (one is terminated in 51-ohm shunt, and the other is unterminated), and three different cable adapters (Adapter Connector

UG–643/U, UG–564/U, or UG–637/U). Selection of the various connectors and their points of actual connection to the unit under test depends on the type of equipment being tested.

(1) Use the shielded rf cable for all connections and extensions. If an alligator clip connection is required at the unit under test, connect one of the test adapters (with alligator clips) at the output end of the rf cable. One of the test adapters supplied with the signal generator has an internal 51-ohm resistor across the clip leads. This serves as a load resistor in applying the generator output to a high input impedance circuit. Use the unterminated adapter when connecting the output to a 50-ohm load.

(2) If the test signal is injected in the vicinity of exposed high-voltage leads, or if there is any chance of shorting out an automatic volume control (avc) voltage, use a series blocking capacitor.

15. Service Upon Receipt of Used or Reconditioned Equipment

a. If used equipment is received for service, check for tags or other sources of information regarding the condition of the equipment.

b. When the condition is doubtful, the equipment should be carefully unpacked (par. 12) and subjected to the equipment performance check (par. 39).

c. A thoroughly reconditioned signal generator should be treated as a new piece of equipment.

CHAPTER 3

OPERATION

Note. This chapter locates, illustrates, and furnishes the operator sufficient information pertaining to the various controls and instruments provided for the proper operation of the equipment.

Section I. CONTROLS AND INSTRUMENTS

16. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control and meter on the equipment. The actual operating instructions are contained in paragraphs 18 through 22.

17. Controls and Their Uses

The following chart lists the controls and instruments of the signal generator (fig. 5) and indicates what they do.

Control	Function
POWER switch	Controls the ac power input. Three positions, ON-OFF-STANDBY. In STANDBY position, only the filament circuit is energized.
FREQ. RANGE-MC selector.	Selects the output signal frequency range in three steps: 50–100 mc, 100–200 mc, and 200–400 mc.
TUNING control	Vernier control for selecting the output test signal frequency
FREQ. IN MEGACYCLES dial.	Indicates signal generator output frequency directly in megacycles. Scale range in use is indicated by the color of the energized indicator lamp.
200–400MC TRIMMER control.	When using the signal generator 200–400 mc range, this trimmer peaks the final doubler stage for maximum output.
OUTPUT control	Varies output signal strength from .1 to 100,000 microvolts. The dial reading indicates microvolts and dbm directly when the signal generator is terminated in a 50-ohm load.
MODULATION selector	Five-position switch. Positions are— EXT, provides for use of external modulation. OFF, provides for unmodulated output signal. 1000~, internal modulation at 1,000 cps. 1600~, internal modulation at 1,600 cps. 20KC, internal modulation at 20,000 cps.
DEV MULT switch	Three-position switch, X1–X5–X10. Selects three different ranges of deviation. Multiplies reading on KILOCYCLES DEVIATION meter.
DEVIATION control	Varies degree of frequency deviation (fine adjustment).
KILOCYCLES DEVIATION meter.	Indicates degree of frequency deviation. Dial face reading is always subject to multiplying factor of DEV MULT switch. Use the scale corresponding to the colored indicator lamp.
OUTPUT meter	Zero center galvanometer that indicates the calibrated output reference level. This level is obtained by rotating the OUTPUT control until the OUTPUT meter is in zero center (SET TO LINE) position. The movable index of the OUTPUT control then is rotated to present a dial reading of 100,000 microvolts. The OUTPUT control then indicates directly in microvolts or dbm across 50 ohms.
Indicator lamps: 50–100, green 100–200, amber 200–400, blue	Indicate the output frequency dial and deviation meter ranges being used by indicating the position of the FREQ. RANGE—MC. selector.

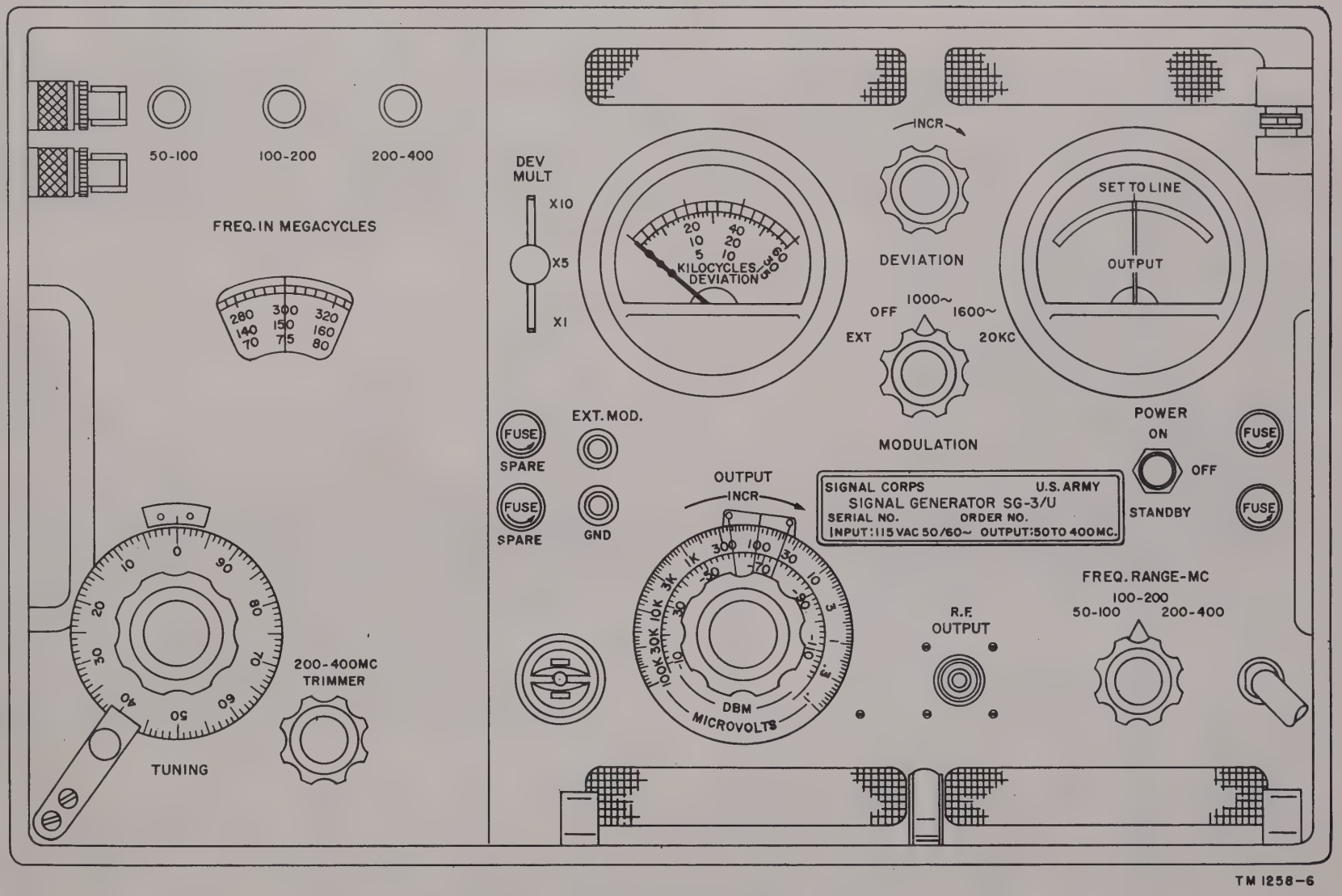


Figure 5. Signal Generator SG-3/U, front panel.

Control	Function
Panel receptacle (unmarked) (standard ac type).	Provides a receptacle for storing the power plug when disconnected.
EXT. MOD. binding posts.	Provide for connection of external audio oscillator with a frequency range between 250 and 70,000 cps. MODULATION switch must be in EXT. position to use these binding posts.
R. F. OUTPUT connector.	The rf output test signal is available at this point.
Fuses F1 and F2	1.5-ampere fuses for the ac input line.

Note. The two remaining front-panel fuses are spares.

Section II. OPERATION UNDER USUAL CONDITIONS

18. Starting Procedures

a. Starting. Connect the ac line cord to the required power source. Place the POWER switch in the ON position. Rotate the FREQ. RANGE-MC selector through its three positions. An indicator lamp (green for position 1, amber for position 2, blue for position 3) should light for each position. If any lamp fails to light, replace it with a spare lamp which is mounted inside the instrument. If all three indicators fail to light, check for blown fuses (F1 and F2) on the front panel. If the signal generator starting indications are normal, allow a 5-minute to ½-hour warmup period before beginning any tests. Following the warmup period, the instrument is ready for use.

Note. If an abnormal result is obtained during the starting procedure, refer to the equipment performance check list (par. 39).

b. Standby Operation. If at any time it is necessary to turn the signal generator off for short periods during any test sequence, throw the POWER switch to the STANDBY position. This will disconnect the plate voltage rectifier. The filament circuit of the signal generator will remain energized, maintaining the proper operating temperature.

c. Output Impedance. The output impedance of the signal generator is 50 ohms. The internal voltage standing wave ratio is less than 1.5.

(1) When working the signal generator into a high impedance circuit of 1,000 ohms and higher, the terminated test adapter is used. The terminated test adapter has an internal 51-ohm resistor across its terminals.

(2) When injecting the test signal into a circuit having an input impedance between 45 and 55 ohms, the rf output cable, adapter fittings, and/or the unterminated test adapter is all that is required for the hookup.

(3) If the signal generator is connected to a circuit of less than 45 ohms, a resistor must be added in series with the output lead to match impedances. *To determine the value of the series resistor required, subtract the input impedance of the unit under test from 50 ohms. This results in a resistance value in ohms for the series resistor required.*

(4) If the signal generator is connected to a circuit having impedance between 55 and 1,000 ohms, a resistor should be connected in shunt to bring the input impedance of the unit under test down to 50 ohms. *To determine the value of the shunt resistor, multiply the impedance of the unit under test by .02. Subtract 1 and divide this answer into the impedance of the unit under test. This results in the value of the shunt resistor required.*

Warning: The use of open leads and alligator clips in the 50- to 400-mc range

will cause serious errors in output voltage measurements. Properly designed constant-impedance pads, matching networks, and fittings should be used wherever possible.

19. Adjustments for Unmodulated Output (Cw)

a. Determine the necessary test frequency.

b. Turn the POWER switch to ON, and allow time for warm up.

c. Turn the FREQ. RANGE-MC switch to the desired frequency range.

d. Set the MODULATION selector to OFF.

e. Adjust the TUNING control for the desired output freqency (indicated on the FREQ. IN MEGACYCLES dial).

f. Connect the R. F. OUTPUT connector to the unit under test.

g. Rotate the OUTPUT control to obtain a center scale reading (SET TO LINE) indication on the OUTPUT meter. (On the 200–400 mc range, set the trimmer for a maximum output.)

h. Set the movable index marker on the OUTPUT control to the 100K microvolts mark. (The OUTPUT control dial then is read directly in dbm or microvolts.)

i. Set the OUTPUT control to the desired signal output strength.

20. Adjustments for Internally Modulated Output

a. Determine the necessary test frequency.

b. Determine the modulation frequency and the frequency deviation desired.

c. Repeat procedure outlined in paragraph 19*b* through *i*.

d. Set the MODULATION selector to 1000 ~ 1600 ~ or 20KC as desired.

e. Set the DEV MULT switch and the DEVIATION control to obtain the desired degree of frequency deviation, as indicated on the DEVIATION meter. Read the colored meter scale that corresponds to the indicator light color. In the 50–100 mc position, read the 0–15 (green) meter scale. For the 100–200 mc position, read the 0–30 (amber) scale. For the 200–400 mc position, read the 0–60 (blue) scale.

21. Adjustments for Externally Modulated Output

a. External modulation is required when the internal modulation frequencies of the signal generator are not sufficient for particular test applications. The required external modulation source is an audio oscillator that produces the desired frequency within the range of 250 to 70,000 cps and an output amplitude of at least 0 dbm into 600 ohms or 774 millivolts.

b. Signal generator adjustments are identical with those given in paragraph 19, except that the MODULATION selector will be placed in the EXT position. Connections are made from the external audio oscillator to the signal generator EXT. MOD. binding posts.

22. Stopping Procedure

To stop operation of the signal generator, place the POWER switch in the OFF position. If the generator is to be idle for only a short period, it is preferable to place the POWER switch in the STANDBY position. This keeps the tube filaments warm until the generator is needed.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

23. General

The operation of Signal Generator AN/URM–70 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. Although every precaution is taken in the design of the equipment to maintain its technical characteristics over a wide temperature and humidity range, adverse conditions may cause large errors in measurements, unless additional precautions are taken. Paragraphs 24, 25, and 26 explain procedures that minimize the effects of these unusual climatic conditions.

24. Operations in Arctic Climates

Subzero temperature, and climatic conditions associated with cold weather, affect the efficient operation of test equipment. Instructions and precautions for operation under such adverse conditions follow.

a. Handle the generator carefully.

b. Keep the equipment warm and dry; if necessary, keep the signal generator in its transit case. Place the POWER switch in the STANDBY position to aid in drying the equipment. When

the signal generator is not in use, place it in its transit case.

c. When servicing the signal generator, remove it from the transit case where there is no danger of a cold draft striking the glass tubes. A sudden draft of cold air might shatter the glass envelope of the tube. If the inclosure construction makes this impossible, place a blanket or some barrier between the source of the draft and the equipment.

d. Moisture will condense on equipment which has been exposed to the cold and brought into a warm room. When the equipment reaches room temperature, dry it thoroughly. Place the POWER switch in the STANDBY position, to speed the heating and drying of the equipment.

25. Operation in Tropical Climates

When operated in tropical climates, test equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground and when it is set up in swampy areas, moisture conditions are more acute. Ventilation is usually very poor, and high relative humidity causes condensation on the equipment whenever its temperature becomes lower than the surrounding air. To minimize this condition, keep the signal generator POWER switch in the STANDBY position; this will operate the tube heaters and help dry the equipment.

26. Operation in Desert Climates

a. The main problem that arises with equipment operation in desert areas is the large amount of sand, dust, or dirt which enters the moving parts of test equipment. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors. Cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent their flapping in the wind.

b. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

c. Keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (par. 32). Pay particular attention to the lubrication. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

d. The drastic fall in temperature at night often causes condensation on the equipment. For protection, keep the signal generator in its transit case and the case under cover.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. PREVENTIVE MAINTENANCE

27. General

a. Usually a number of tools, materials, or tool equipment kits are furnished with the equipment or supplied to the organization for use with the equipment.

b. The organizational maintenance that can be performed on Signal Generator AN/URM–70 depends on the existing military regulations (Standing Operating Procedure), the existing tactical situation, and also on the tools and other test equipment issued.

28. Tools and Materials

a. Tools and materials used, but not supplied, with Signal Generator AN/URM–70 are listed in (1) and (2) below. The tools and materials contained in Tool Equipment TE–41 are listed in Department of the Army Manual SIG 6–TE–41.

(1) *Tools.*
1 Tool Equipment TE–41
1 Tube Puller TL–201

(2) *Materials.*
Orange stick
Cheesecloth, bleached, lint-free
Carbon tetrachloride
Paper, sand, flint #000
Solvent, Dry Cleaning (SD)

b. Three Allen wrenches are supplied with Signal Generator AN/URM–70: No. 6 (stock No. 6R57400–6), No. 8 (stock No. 6R57400), and No. 10 (stock No. 6R55496). They are secured by electrical clips on the inside right panel of the dust cover.

29. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its object is to prevent certain troubles from occurring.

30. General Preventive Maintenance Techniques

a. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride. Do not use emery cloth. Wipe them dry with a clean dry cloth and inspect.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

b. Dry compressed air may be used to remove dust from inaccessible places. The pressure used should not exceed 60 pounds per square inch. Be careful, or mechanical damage from the air blast may result.

c. For further information on preventive maintenance techniques, refer to TB SIG 178.

31. Use of Preventive Maintenance Forms (figs. 6 and 7)

a. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communications officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items on figures 6 and 7 are partially or totally applicable to Signal Generator AN/URM–70. References in the item column are

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 32 a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 32 a (2)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 32 a (3)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 32 a (4)							
6	CHECK FOR NORMAL OPERATION. PAR. 32 a (5)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS.		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 32 a (6)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 32 a (7)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 32 a (9)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 32 a (8)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-238 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM1258-39

Figure 6. DA Form 11–238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (1) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	COND.
(1)	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 32 a (1)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	
(3)	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 32 a (2)	
(4)	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 32 a (3)	
(5)	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 32 a (4)	
(6)	CHECK FOR NORMAL OPERATION. PAR. 32 a (5)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS.	
(8)	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 32 a (6)	
(9)	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 32 a (7)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	
(12)	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 32 a (8)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
(15)	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 32 a (9)	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

NO.	ITEM	COND.
(19)	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 32 b (1)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
(21)	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 32 b (2)	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS.	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS.	
(24)	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 32 b (3)	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
(32)	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 32 b (4)	
(33)	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
37	MOISTURE AND FUNGIPROOF.	

38 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-239 REPLACES DA [illegible] FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—10—64383-1

TM1258-40

Figure 7. DA Form 11-239.

to paragraphs that contain additional detailed information.

32. Performing Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. External Items.

(1) Check for completeness and general condition of the generator. The components are listed in paragraph 7.

(2) Clean dirt and moisture from the front panel, power receptacle, connectors, and dial and meter windows.

(3) Inspect the seating of fuses F1 and F2 and lamps I1, I2, and I3.

(4) Inspect the controls for binding, scraping, excessive looseness, and for positive action.

(5) Check the generator for normal operation (par 39).

(6) Inspect exposed metal surfaces of the generator for rust and corrosion.

(7) Inspect power cord and output cables for breaks, deterioration, and loose connectors.

(8) Inspect for looseness of accessible items such as the front-panel meters, TUNING dial mechanism, OUTPUT control, switches, knobs, and jacks.

(9) Inspect the front-panel meters M1 and M2 for any signs of damage.

Caution: Disconnect all power from the generator before performing the operations in *b* below. Upon completion, reconnect power and check for satisfactory operation of the signal generator.

b. Internal Items.

(1) Inspect tubes for loose envelopes and insufficient spring tension on the tube clamps. Test all tubes for normal emission (fig. 4).

(2) Inspect all fixed capacitors in the power supply for leaks or bulging.

(3) Inspect all resistors and insulated bushings for cracks, chipping, and discoloration.

(4) Inspect transformer T1 and coils L1 and L2 for overheating.

Section II. LUBRICATION AND WEATHERPROOFING

33. General Lubrication Procedures

a. The signal generator is constructed to be free from excessive gear loading and high-speed operating mechanisms. The manufacturer's lubrication normally will last the life of the instrument, and periodic lubrication is not required.

b. If binding of a front-panel control develops, send the equipment to an instrument repair depot. The mechanical assemblies of the signal generator contain antibacklash gearing, precision mechanically ganged stages, and other properties that require the skill of instrument repair personnel. Mechanical alinement or lubrication normally will require disassembly of the binding linkage. This should be done only by a person skilled in repairing intricate assemblies. When lubricating, use Grease GL QMCS/N14–G–610–900.

c. When the equipment is subjected to moisture, dust, dirt, or other conditions that prevail in unusual locations and climates, blow the mechanical assemblies clean with a low pressure air hose, and wipe thoroughly. This usually will be sufficient to remove harmful particles or moisture.

34. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, require special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72, Tropical Maintenance of Ground Signal Equipment.

c. Arctic Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66, Winter Maintenance of Signal Equipment.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas

subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75, Desert Maintenance of Ground Signal Equipment.

35. Rustproofing and Painting

a. A badly scarred or damaged front panel or dust cover may be touched up so that its bared surface will not corrode. Clean the surface down to the bare metal; use No. 000 sandpaper to obtain a smooth metallic finish.

Caution: Do not use steel wool. Minute particles might enter the signal generator and cause harmful internal shorting or grounding of circuits.

b. Before applying touch-up paint to the bared surface with a small brush, remove any rust or corrosion from the metal surface by cleaning with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparations, before the metal can be painted. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

36. General

a. The troubleshooting and repairs to be performed at organizational maintenance level (operators and repairmen) are necessarily limited in scope by the tools, test equipment, and replaceable parts issued. Troubleshooting is based on performance of the equipment and use of the senses in determining such troubles as defective tubes, broken cables, burned-out fuses, etc.

b. The paragraphs which follow in this section aid in determining which of the stages is defective and in localizing the fault in that stage to the defective item, such as a tube or fuse.

37. Visual Inspection

a. Equipment troubles may be caused by one or more of the following conditions:

(1) Loose or unconnected power source cable.
(2) Poor connections at input or output cables or wires.
(3) Burned-out fuse or fuses.
(4) Defective tubes.
(5) Leaking capacitors or transformers.
(6) Mechanical damage.
(7) Loose or damaged wiring or solder joints.

b. When a failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the signal generator. Obtain information from the operator of the equipment regarding performance at the time the trouble occurred.

c. Check overheating or corrosion discolorations.

38. Troubleshooting by Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 39) will help the operator locate trouble in the equipment. This list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. Follow the items in numerical sequence.

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indication column.

c. Normal Indications. The normal indications listed, include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, he should apply the recommended corrective measures.

d. Corrective Measure. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the table to paragraph 59 indicates that the trouble cannot be corrected during operation and that troubleshooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, troubleshooting is necessary.

39. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	1	Rf cable	Connected to unit under test.		
	2	POWER switch	Set to OFF		
	3	Line cord	Connected to power source.		
	4	POWER switch	Set to STANDBY	One of the frequency range indicator lamps will light.	Check power source, power cable, fuses, and panel lamps.
	5	MODULATION selector	Set to OFF		
	6	DEVIATION control	Fully counterclockwise		
	7	OUTPUT control	Fully counterclockwise		
	8	DEV MULT switch	Set in X10 position		
START	9	POWER switch	Set to ON	Output indicator will swing to left.	Check tubes V12, V13, V14, and V15.
EQUIPMENT PERFORMANCE	10	FREQ. RANGE–MC switch.	Rotate through all three positions.	Respective indicator lamp will light.	Check lamps and range switch.
	11	FREQ. RANGE–MC and tuning controls.	Select any output frequency in 50–100 mc range.		
	12	Turn OUTPUT control slowly clockwise.	Produce a cw output signal at R. F. OUTPUT connector.	Correct signal indication at unit under test. OUTPUT indicator pointer will swing toward right.	Check all electron tubes except V1, V2, V3, V4, V10, V11, V16, and V17. Refer to troubleshooting procedures (par. 59).
	13	Same as item 11	Use 100–200 mc range.		
	14	Same as item 12	Same as item 12	Same as item 12	Same as item 12.
	15	Same as item 11	Use 200–400 mc range and trimmer.		
	16	Same as item 12	Same as item 12	Same as item 12	Same as item 12.
	17	DEVIATION control (MODULATION at 1000 ~).	Slowly increase (clockwise).	Indication on DEVIATION meter, and unit under test.	Check tubes V1, V2, V3, V4, V10, and V11. Refer to paragraph 59.
	18	MODULATION selector	Select and check all three modulation frequencies: 1,000, 1,600, and 20,000.	Proper frequency indication at unit under test.	Same as item 17.
	19	DEV MULT switch	Vary through all three positions.	Indication of signal deviation multiplying at unit under test.	Check output connector, all vacuum tubes, and DEV MULT switch.
STOP	20	POWER switch	Place in OFF position	Indicator lamp will go out.	Disconnect power cord and check POWER switch.

CHAPTER 5

THEORY

40. Introduction

This chapter contains a description of the electrical circuitry of Signal Generator SG–3/U. The description provides an understanding of each stage and aids troubleshooting and repair.

41. Description of Operation

Signal Generator SG–3/U is shown in the block diagram (fig. 8). A brief description of each stage shown is contained in the paragraphs which follow. For more detailed overall circuit information, refer to the complete schematic of Signal Generator SG–3/U (fig. 44).

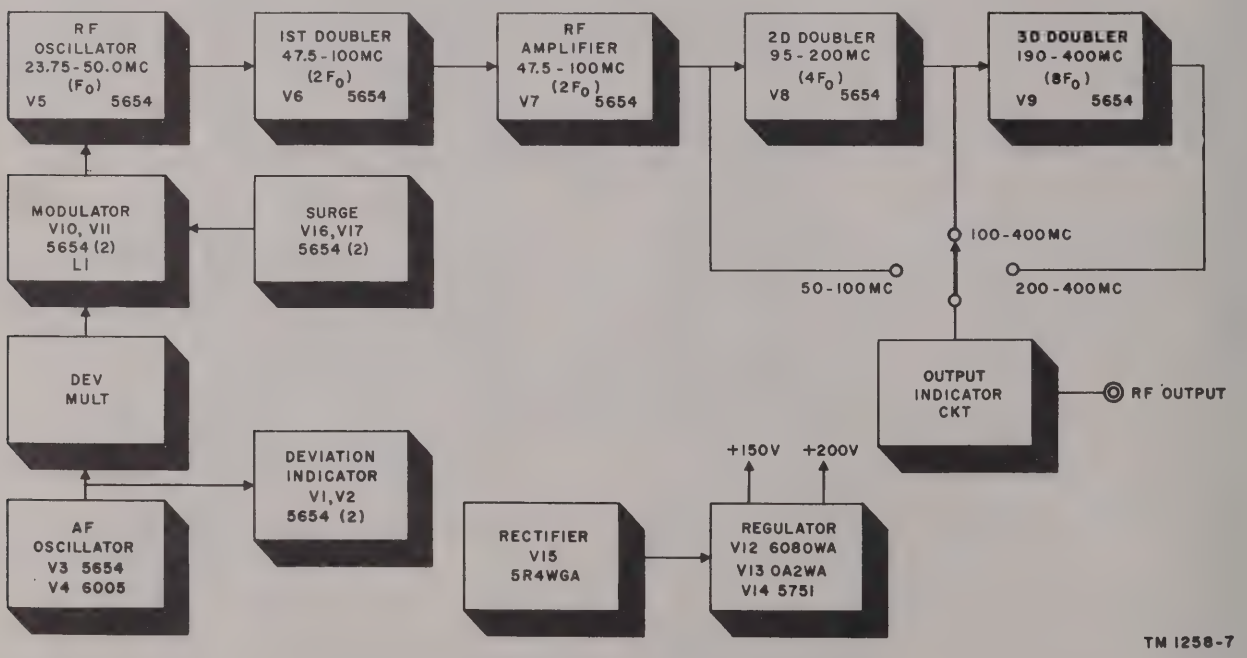


Figure 8. Signal Generator SG–3/U, block diagram.

a. Rf Oscillator. Rf oscillator V5 is a modified Colpitts oscillator with a range of 23.75 to 50 mc. The fundamental oscillator frequency is determined by a setting of the manually operated TUNING control. When the signal generator is used to provide an fm signal, a saturable reactor, which is part of the oscillator tank circuit, frequency-modulates the oscillator output signal. The rf output developed in this stage is fed to the first doubler stage.

b. First Doubler. First doubler V6 amplifies and doubles the frequency of the oscillator output signal. Its output signal voltage at a frequency between 47.5 to 100 mc is applied to rf amplifier V7.

c. Rf Amplifier. This stage amplifies the signal output of the first doubler without changing the frequency of the 47.5- to 100-mc input signal. The output of the rf amplifier is applied to the FREQ. RANGE-MC selector switch and to the second doubler stage. When the FREQ. RANGE-MC switch is in the 50–100 mc position, the output of the rf amplifier serves as the signal generator output signal.

d. Second Doubler. The output signal from the first doubler is amplified by V7 and then the frequency is doubled by second doubler V8. The output frequency of this stage (95.0 to 200 mc) is four times the fundamental oscillator frequency.

The output signal of the second doubler is applied to third doubler V9 and to the FREQ. RANGE-MC switch which, when turned to the 100–200 mc position, makes the output of the second doubler the signal generator output signal.

e. Third Doubler. In a manner similar to that of the preceding doubler stages, third doubler V9 amplifies and multiplies the frequency of the output signal of the second doubler. The output frequency of this stage is 190 to 400 mc or eight times the fundamental oscillator frequency. The output signal of this stage is available at the RF OUTPUT jack when the FREQ. RANGE–MC selector is set at the 200–400 mc position.

f. Output Indicator. A portion of the output signal of the rf amplifier, the second doubler, or third doubler, depending on the setting of the FREQ. RANGE–MC selector, is applied to the output indicator circuit. This circuit consists of a galvanometer connected in a bridge circuit and is used as a visual calibrating device. A center scale or SET TO LINE reading on the meter indicates that the rf output is 100,000 microvolts.

g. Audio Oscillator. The audio signal which is used to frequency-modulate the rf oscillator is generated by audio oscillator V3 and V4. The frequency of oscillation is controlled by the MODULATION switch. Oscillations are produced at one of three fixed frequencies: 1,000 cps, 1,600 cps, or 20,000 cps. The output of the audio oscillator is applied to the deviation indicator and to the deviation multiplier. The amplitude of the audio signal applied to these stages is varied by the DEVIATION control.

h. Deviation Indicator. The deviation indicator stage converts the signal output of the audio oscillator into a visual indication of the frequency deviation contained in the signal generator output signal. The amount of frequency deviation is read from KILOCYCLES DEVIATION meter M1, a direct-current (dc) microammeter calibrated in kilocycles. This reading, when multiplied by the setting of the DEV MULT switch (X1, X5, or X10), is the amount of frequency deviation.

i. Deviation Multiplier. The deviation multiplier is a resistive attenuator which controls the amplitude of the audio voltage that is fed to the modulator. The amount of attenuation is controlled by the DEV MULT switch.

j. Modulator. This stage consists of amplifier V10, modulator V11, and saturable reactor L1. The audio signal from the deviation multiplier is amplified by V10 and applied to modulator V11. The output signal of V11 is applied to saturable reactor L1. The inductance of L1 is made to vary with the amplitude of the audio oscillations. Since L1 is connected across a portion of the rf oscillator tank circuit, any change in the inductance of L1 produces a corresponding change in the output frequency of the rf oscillator. The modulator is capable of producing a maximum frequency deviation of ±75 kc. After frequency multiplication by the first, second, and third doublers, the amount of deviation in the rf oscillator output signal is a maximum of ±150 kc on the 50–100 mc range, ±300 kc on the 100–200 mc range, and ±600 kc on the 200–400 mc range.

k. Surge Circuit. The surge circuit, consisting of V16 and V17, applies a pulse of voltage to saturable reactor L1 at the time the signal generator is turned on to reduce its inductance instantly to the proper operating value.

l. Rectifier. Tube V15, connected in a full-wave rectifier circuit, furnishes a positive 400-volt dc to the voltage regulator circuit.

m. Voltage Regulator. The voltage regulator, consisting of V12, V13, and V14, supplies regulated potentials of +150 volts dc and +200 volts dc for the various circuits in the signal generator.

42. Rf Oscillator V5

a. The rf oscillator circuit (fig. 9) uses a type 5654 rf pentode connected as a triode in a circuit equivalent to a Colpitts oscillator. The oscillator has a frequency range of 23.75 to 50 mc. The frequency of oscillation is determined by the tank circuit consisting of center-tapped inductance L2, trimmer capacitors C18 and C19, split-stator main tuning capacitor C16A and C16B, and capacitor C17. The in-phase feed-back voltage necessary to sustain oscillation is coupled by C15 to the grid of V5. Assume that a positive signal voltage appears at the grid of V5. After amplification by V5, the signal voltage with respect to ground is negative at the plate side of L2 and positive at the grid side. This is because the junction of tuning capacitor C16A and C16B is connected to ground. The signal voltage across C16A and the lower half of L2 is, therefore, of the proper polarity to reinforce the existing signal voltage at the grid of V5. The amount of feed-back voltage coupled to the grid circuit is determined by the ratio of capacitance between the grid side to ground and from the plate side to ground in the

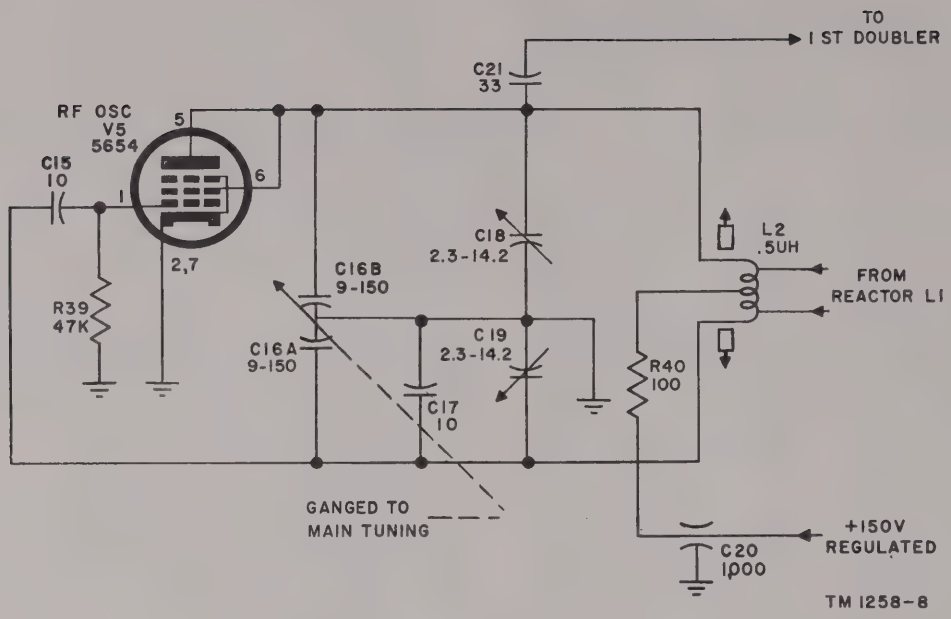


Figure 9. Rf oscillator circuit.

tuned circuit. Capacitor C17 balances the distributed shunt capacitance introduced into the tank circuit by output coupling capacitor C21.

b. The output frequency is changed by varying the capacitance of C16A and C16B. This capacitor is linked mechanically to the manually adjusted front-panel TUNING control. Trimmer capacitors C18 and C19 are used to adjust the high-frequency (50 mc) end of the oscillator tuning range. The low-frequency end of the tuning range is adjusted by changing the position of the powdered iron cores in each end of tank coil L2. Plate voltage for V5 is obtained from the 150-volt regulated supply. Grid leak bias is developed across resistor R39. A decoupling filter, consisting of resistor R40 and capacitor C20, prevents rf energy from entering the B+ supply line.

c. The oscillator circuit is frequency-modulated by changing the effective inductance of the tuned circuit. The two taps on tank coil L2 are connected to the signal winding of saturable reactor L1. Any variations in the inductance of the reactor produce a corresponding shift in oscillator frequency. A more detailed description of the function of this reactor is contained in paragraph 43.

43. Modulator V10 and V11

a. The modulator circuit (fig. 10), which consists of two triode connected type 5654 pentodes, amplifies the output signal of audio oscillator V3 and V4 and applies it to saturable reactor L1 which, in turn, frequency-modulates the output signal of the rf oscillator. The control winding of L1 is connected in a voltage divider circuit which includes potentiometers R65, R66, and R100, and temperature compensating resistor RT2. The signal winding of L1 is connected across a portion of oscillator tank coil L2. The control and signal windings are arranged so that a negligible amount of mutual inductance exists between windings. Consequently, energy is not transferred from one winding to the other. However, the permeability of the core material, which is common to both windings, changes with variations in the amplitude of current flowing in the control winding. The steady dc bias current, which is set by bias potentiometer R100 and which flows through the control winding of L1, reduces the permeability of the core to a predetermined point. The amplified audio-frequency output of V10 and V11 coupled through C52 is superimposed upon the dc bias and varies the permeability of the core material about a predetermined point. As the current through the control winding increases, the permeability of the core material decreases, thereby decreasing the inductance of the signal winding. Since the signal winding is connected across a portion of oscillator tank coil L2, the effective inductance of the oscillator circuit is reduced and the frequency of oscillation is increased. Conversely, a decrease in current

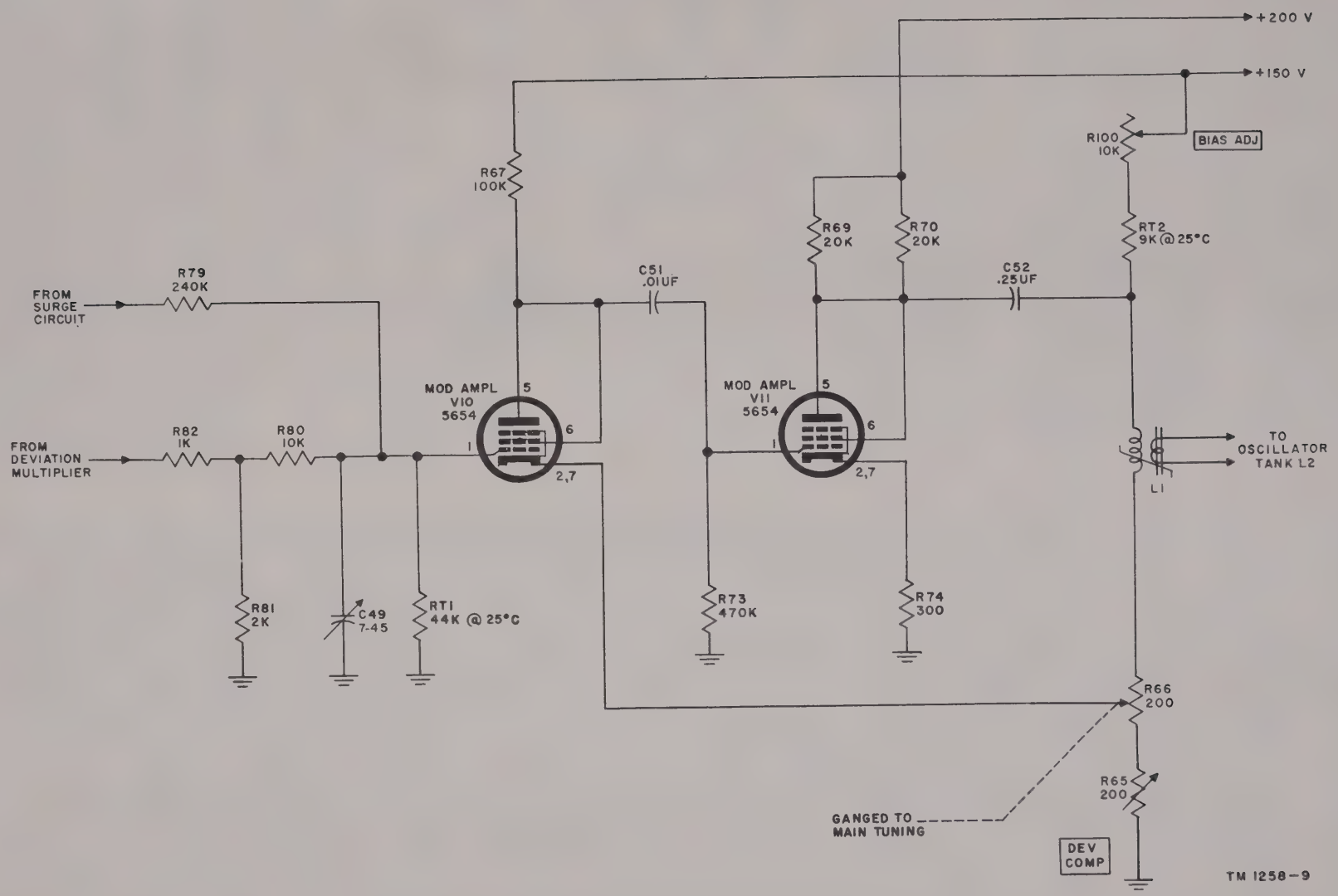


Figure 10. Modulator V10 and V11.

through the control winding lowers the frequency of oscillation. Since the core material exhibits slight permanent magnetic characteristics, it is necessary to increase the bias current momentarily to a value considerably exceeding that flowing at the operating point to prevent a center frequency shift when modulation first is applied. This is accomplished automatically by the surge circuit (par. 51), which delivers a positive pulse to the modulator and the control winding; this stabilizes the reactor at its operating point.

b. For stability of operation V10 and V11 are connected in a degenerative feed-back circuit. The audio signal voltage from the deviation multiplier is applied across grid resistor RT1 of V10 through the T-pad attenuating network consisting of R82, R81, and R80. After amplification and inversion by V10, the audio signal developed across R67 is coupled by C51 to the grid of V11. Resistor R73 serves as the grid resistor of V11. Cathode resistor R74 is the source of bias and is unbypassed to introduce a small amount of degeneration at all frequencies. Tube V11 also amplifies and inverts the audio signal. A portion of the audio output voltage developed across R69 and R70 appears across resistors R66 and R65 which serve as the cathode resistor of V10. The positive dc potential, obtained in addition to the voltage drop produced by normal tube current flow at the arm of R66, serves as the bias voltage for V10. Potentiometer R65 DEV COMP sets the minimum cathode resistance and establishes the minimum operating bias. Potentiometer R66 controls the amount of out-of-phase audio feed-back voltage which is introduced between cathode and ground of V10. This potentiometer is linked mechanically to the TUNING control of the signal generator. As the TUNING control is turned from the lowest to the highest frequency, the amount of degenerative feed-back voltage applied to V10 is increased and the audio current flowing in L1 is decreased. This is done to provide a uniform frequency deviation over the entire range of operating frequencies, since equal changes of inductance in the signal winding of L1 produce a greater deviation at higher frequencies than at lower frequencies. By decreasing the amount of signal voltage that is applied to the control winding of L1, the inductance of the signal winding is decreased proportionately to maintain uniform frequency deviation.

c. Modulators V10 and V11 tend to produce greater deviation at the higher audio frequencies for equal amplitude of audio signal applied to V10. To obtain a uniform deviation over the higher modulating frequency range, C49 is adjusted to decrease the signal amplitude to V10. The signal applied to V10 is decreased at a rate equal to that at which V10 and V11 tend to produce the greater deviation. Capacitor C49 reduces the grid impedance of V10, hence the proportion of modulating signal applied, as the frequency of the modulation signal increases. The adjustment of C49 usually is made only when L1 is replaced.

44. First Doubler V6

a. The signal output of the rf oscillator is coupled by C21 (fig. 9) to the grid of first doubler V6 (fig. 11). Grid current flowing through grid return resistor R41 produces the necessary self-bias.

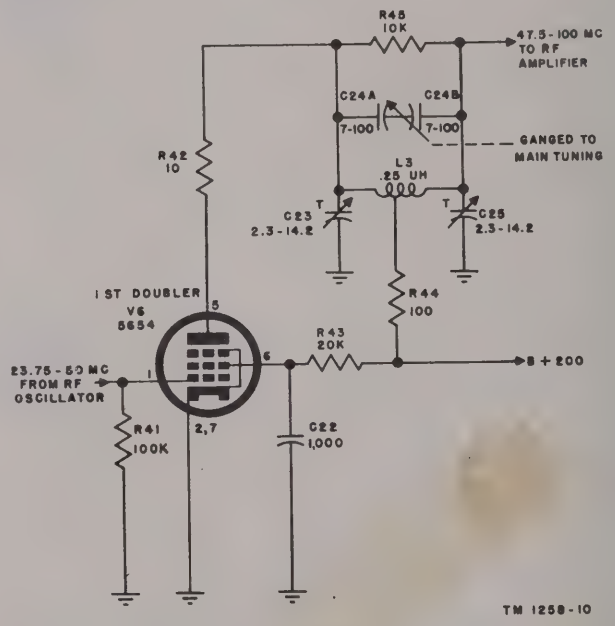


Figure 11. First doubler stage.

b. The plate load of V6 is the tuned circuit composed of L3, split-stator tuning capacitor C24, and trimmer capacitors C23 and C25. Capacitor C24A and C24B is ganged to the TUNING control and tunes this stage to twice the fundamental oscillator frequency (47.5 to 100 mc). Resistor R45, connected across the tuned circuit, broadens the frequency response of the circuit to handle the wide frequency deviation. The 200-volt regulated plate supply voltage for V6 is applied through de-

coupling resistor R44 to the tap on coil L3. Screen grid voltage for V6 is supplied through voltage dropping resistor R43 and is bypassed by capacitor C22. The output from V6 is fed to the grid circuit of rf amplifier V7 through R46 and coupling capacitor C26 (fig. 12).

45. Rf Amplifier V7 and Variable Attenuator

a. The rf amplifier circuit (fig. 12) is identical with the first doubler circuit with the two following exceptions: The plate circuit is tuned to the frequency applied to the grid. A portion of the rf amplifier output is coupled to the variable attenuator and is the signal generator output signal in the 500–100 mc range.

b. The variable rf output attenuator E2 is made up of coupling coil L15 and impedance transfer network R50, C31, and L16. The signal developed across coil L16 is transferred by 50-ohm coaxial cable W3, to the 50–100 mc contact of FREQ. RANGE-MC selector S5 (fig. 44). The output signal level at connector J1 (fig. 44) is determined by the degree of coupling between L15 and L14. The three variable attenuators E2, E3, and E4 are ganged, and the selected attenuator is connected to output connector J1 through switch S5.

c. A portion of the output of V7 also is coupled through resistor R53 and capacitor C33 (fig. 13) across grid resistor R54 to the grid of second doubler V8.

46. Second Doubler V8

a. The second doubler circuit (fig. 13) is similar to the rf amplifier except that its plate circuit is tuned to twice the frequency of the grid input signal. The plate circuit consists of coil L17, tuning capacitor C36A and C36B, and trimmer capacitors C37 and C39. The tank circuit is tunable through the 95- to 200-mc frequency range. The second doubler variable attenuator E3 is ganged to the one in the rf amplifier. It consists of coils L18 and L19, capacitor C35, and resistor R56.

b. A portion of the output of V8 also is coupled through capacitor C38 across grid resistor R59 to the grid of third doubler V9.

47. Third Doubler V9

a. The third doubler circuit (fig. 13) is similar to the second doubler circuit except that the tuned plate circuit and attenuator E4 operate in the 200–400 mc range. The attenuator is ganged with the attenuators in the rf amplifier and second doubler. The output of this attenuator is the generator output when the FREQ. RANGE-MC switch is in the 200–400 mc position.

b. At the high operating frequencies of the third doubler, slight changes in component values have a large effect on the response of the stage. Trimmer C46 adjusts the plate tank for maximum output. This trimmer is adjustable at the front-panel 200–400 MC TRIMMER control.

48. Output Indicator Circuit

a. The output indicator circuit (ng. 14) is a bolometer bridge circuit which uses a galvanometer to indicate bridge balance.

b. Galvanometer M2 has its mechanical zero at center scale and is connected between the movable arm of potentiometer R130 and the junction of the other two arms of the bridge. One arm of the bridge consists of thermal compensating resistor RT3 and potentiometer R129. A second arm of the bridge consists of bolometer RT4 which is returned to ground through attenuator coils L16, L19, L22, and resistors R128 and R126. The other two arms of the bridge are the portions of each side of the movable arm of potentiometer R130. The circuit operates as follows: Direct current from the plate supply flows through all arms of the bridge; rf currents flow only through the bolometer arm of the bridge. Capacitor C96 bypasses one end of RT4 to ground for rf currents. The bridge is balanced by adjusting potentiometer R130 for an output of 100,000 microvolts across a 50-ohm load at RF OUTPUT receptacle J1. With the bridge balanced, a decrease in the rf input level causes the bolometer resistance to decrease. A decrease in resistance unbalances the bridge and causes the galvanometer to be deflected below center scale. An increase in the rf level, increases the bolometer resistance and unbalances the bridge deflecting the galvanometer needle above center scale. The OUTPUT control dial is calibrated at each use by adjusting the OUPUT control for a center scale (SET TO LINE) reading on the OUTPUT meter and setting the movable index on the OUTPUT dial to 100,000 microvolts. The rf output of the generator now may be read directly in microvolts or dbm from the OUTPUT control dial.

c. Potentiometer R129 permits the temperature compensating characteristics of that arm to be varied even though the characteristic of temperature compensating resistor RT3 is fixed

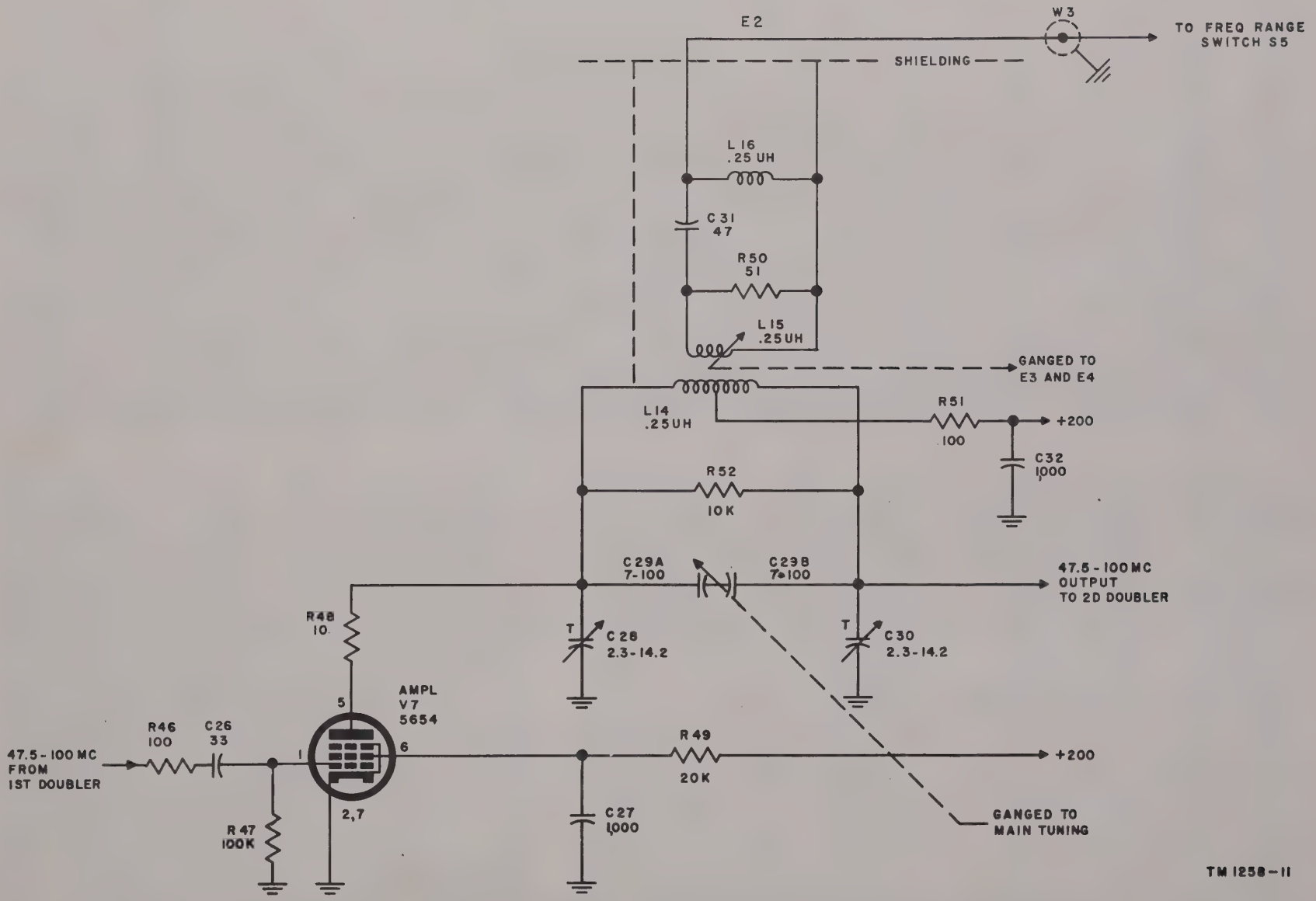


Figure 12. Rf amplifier V7.

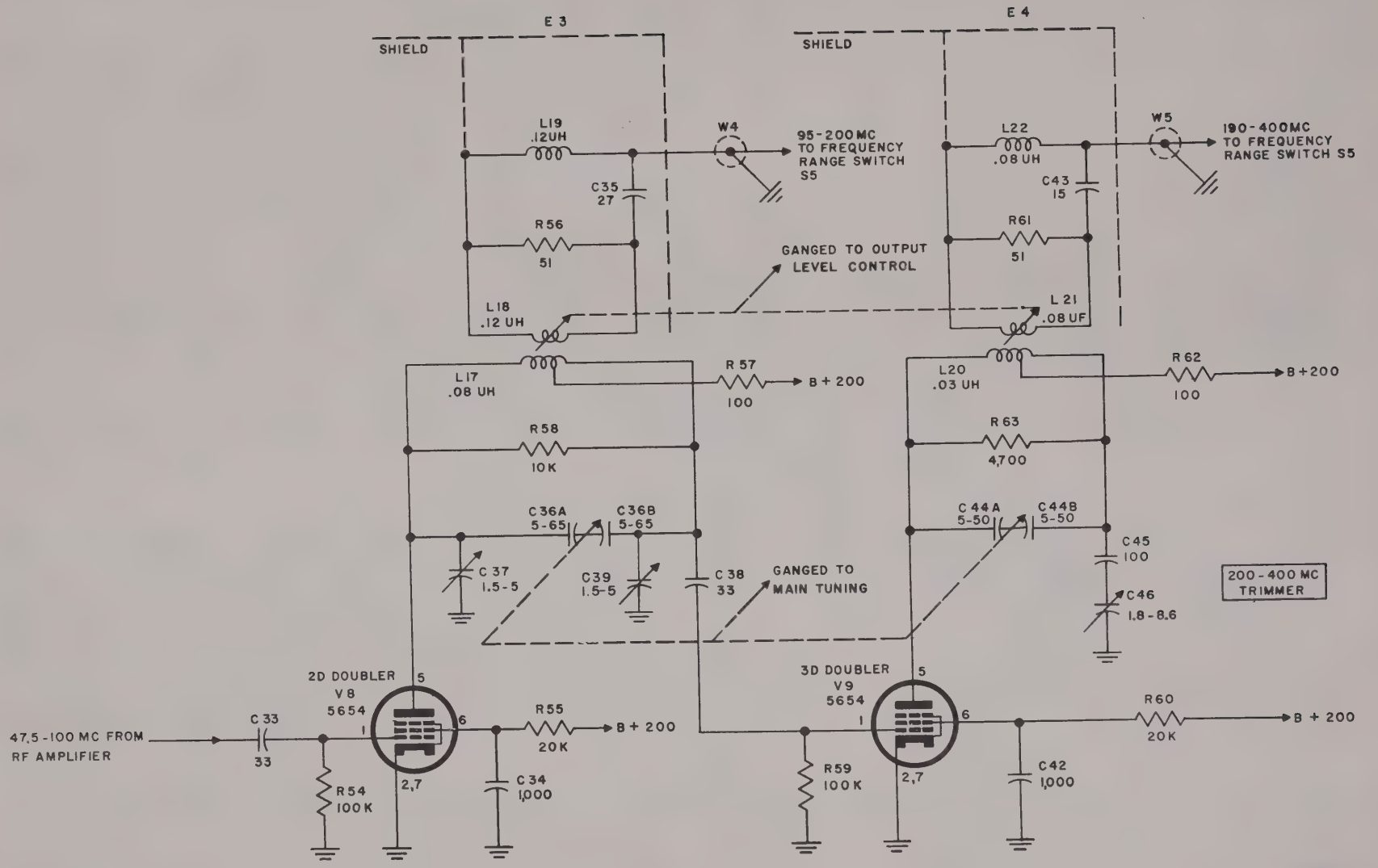


Figure 13. Second and third doublers.

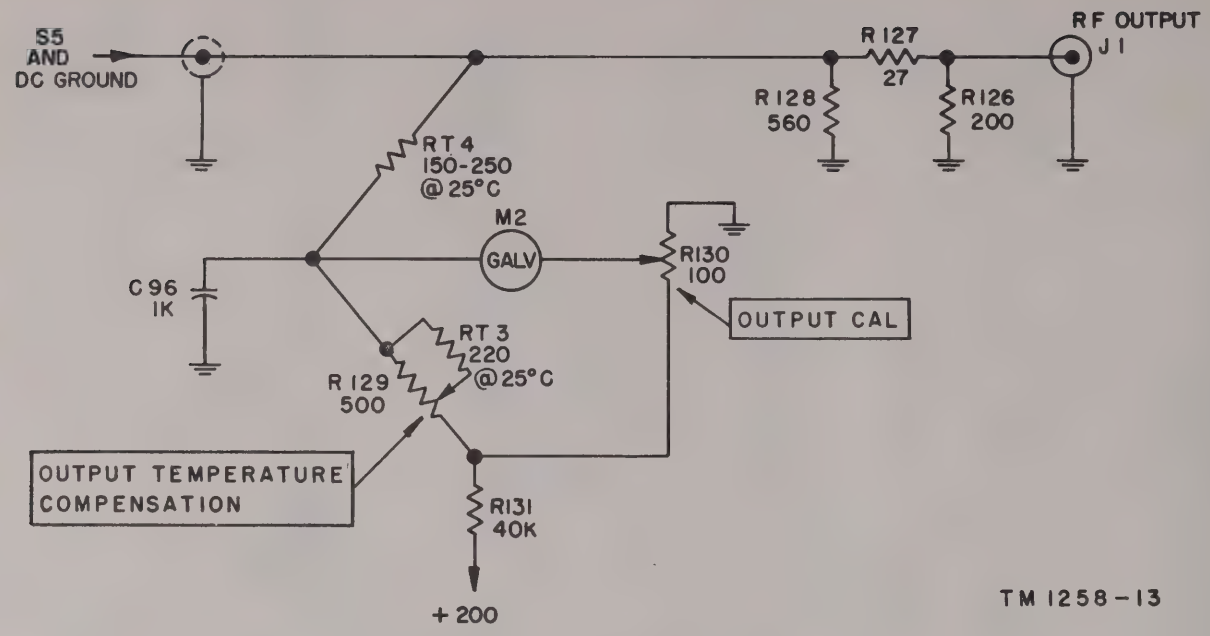


Figure 14. Output indicator circuit.

49. Audio Oscillator V3 and V4

a. The audio-oscillator circuit (fig. 15) is basically a wide-band resistance-coupled audio amplifier with a resistance-capacitance regenerative feedback circuit called a Wien bridge. The circuit operates in the following manner: If the positive half-cycle of a 1,000-cps audio signal appears at the grid of V3, the signal is amplified and inverted by V3. The negative signal, developed across plate resistor R19, is applied through C4 across R28 to the grid of pentode amplifier V4. The signal again is amplified and inverted and the positive signal, developed across plate resistors R17 and R18, is coupled by C2B to the grid of V3 through R23, C9, C10, and C12 in parallel, and section 2 of switch S2. Since the original signal at the grid of V3 is positive, the feed-back voltage is of the proper polarity to sustain oscillations. The positive feed-back bridge elements R26 with C8 and C11, and R23 with C9, C10, and C12, are frequency sensitive and attenuate all except the desired feed-back frequencies. The oscillator will oscillate at the frequency determined by the bridge elements. The positive output of V4 also is applied through C2B across R27 and E1. Since E1 serves as the cathode resistor of V3, the voltage appearing across E1 is degenerative or out of phase. If the degenerative voltage applied to the cathode is greater than that applied to the grid, the oscillator will not function. By adjusting R27, the proper amount of degenerative feedback is applied to permit oscillations and to assure stability of operation.

b. The frequency determining elements of the Wien bridge audio oscillator peculiar to the 1000~ position of MODULATION switch S2 are capacitor C8 and resistor R26 in parallel and resistor R23 as shown in figure 15. One of the four legs of the Wien bridge oscillator is made up of C8, R26, and C11 in parallel. The second leg is made by resistor R23 in series with paralleled capacitors C9, C10, and C12. The third and fourth legs of the bridge are made by R27 and ballast lamp E1. Trimmer capacitor C8 is used for the exact adjustment of 1,000 cps. The overall frequency range of the oscillator is adjusted by C9 to include 1,000 cps and 20,000 cps within its limits. The frequency determining elements peculiar to the 1600~ position of MODULATION switch S2, are C7 and R25 (fig. 44) in parallel and R22. In the 20KC position, the frequency determining elements are C6 and R24 in parallel and resistor R21. The amplitude of the audio oscillations is maintained at a constant level by degenerative feedback controlled by the action of E1. As the amplitude of audio oscillations increases, the resistance of ballast lamp E1 increases proportionately. As a result, the amount of degenerative feedback developed across E1 is increased, and the amplitude of oscillations is decreased. Additional degenerative

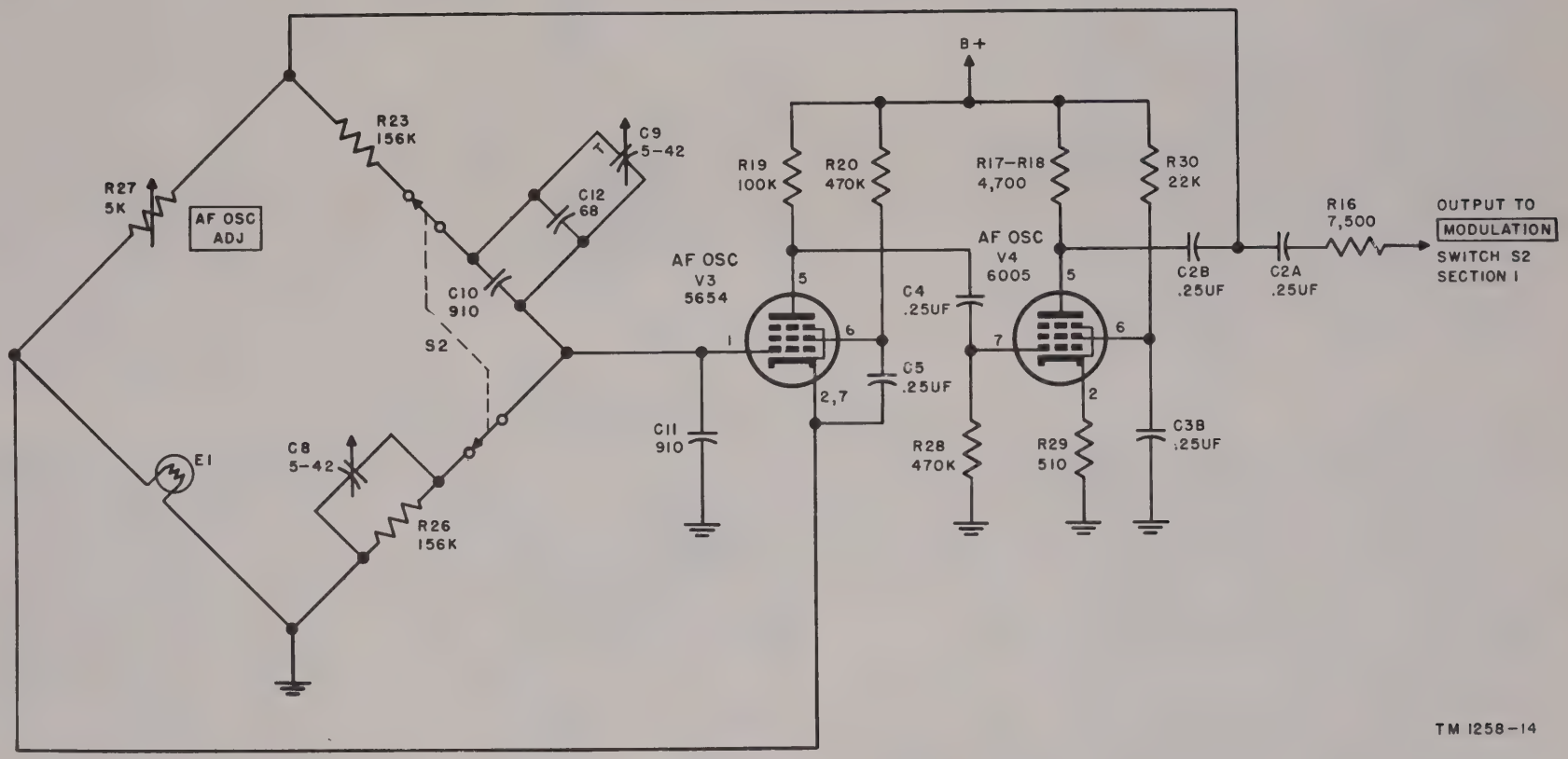


Figure 15. Audio-oscillator circuit, 1,000-cps operation.

action across unbypassed cathode resistor R29 of V4 assures stability of operation.

c. The audio output signal at the plate of V4 is fed to DEVIATION control R15 (fig. 16) through capacitors C2B and C2A, resistor R16, and MODULATION switch S2 section 1 rear (fig. 44). Screen voltage for V3 and V4 is applied through resistors R20 and R30. Capacitors C5 and C3B are screen bypass capacitors.

50. Deviation Indicator Circuit V1 and V2

a. The deviation indicator circuit (fig. 16) consists of V1, a type 5654 pentode, operating as a voltage amplifier; tube V2, a type 5654 connected as a diode, operating as a rectifier; and a 200-microampere meter (M1) calibrated to indicate deviation in kc.

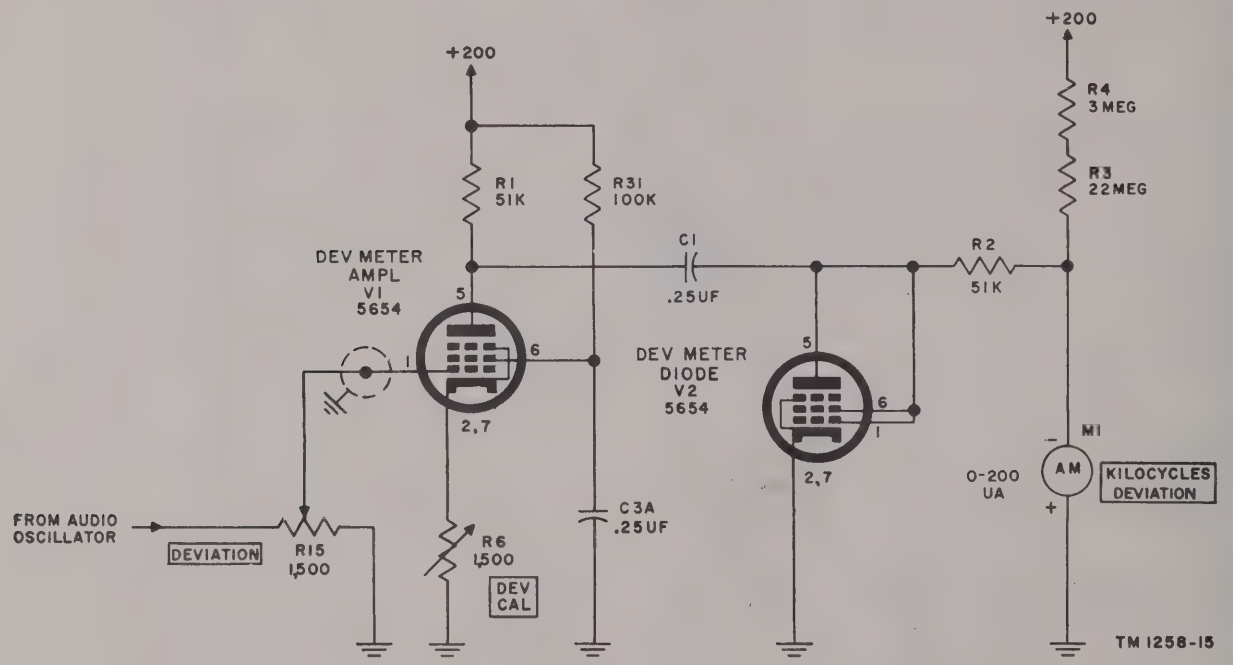


Figure 16. Deviation indicator circuit.

b. The output from audio oscillator V3 and V4 is fed through the MODULATION switch to DEVIATION control potentiometer R15, which also serves as the grid resistor for V1. The voltage developed across R15 also is fed to DEV MULT switch S1 through isolating resistor R7 (fig. 44). After amplification by V1, the positive half-cycles of the audio signal cause C1 to charge through V2. During the negative plate voltage swings, C1, unable to discharge through V2, discharges through R2 and M1. The amount that the needle of M1 is deflected is dependent upon the amplitude of the discharge current of C1 which, in turn, is dependent upon the amplitude of the audio signal. The amplitude of the audio signal determines the amount of frequency deviation in the rf output signal. The proportionate dc current flowing through meter M1 is representative of the frequency deviation.

c. Potentiometer R6 (fig. 16) in the cathode of V1 is a deviation meter adjustment. It adjusts the operating bias of V1. Resistors R3 and R4 in series with M1 cancel the effect of diode contact potential which, otherwise, would produce a current through M1 with a consequent error in deviation indication, particularly at low deviation levels. Screen voltage for V1 is obtained from the positive 200-volt source and is applied through resistor R31. Capacitor C3A is the screen bypass capacitor.

d. Meter M1 has a calibrated scale from which the deviation in kc can be read directly for any of the three rf bands when DEV MULT switch S1 is in the X1 position. In the X5 and X10 positions of S1, the meter readings must be multiplied by 5 and 10, respectively, to determine the amount of deviation. When DEV MULT switch S1 is in the X10 position (fig. 44), the audio voltage across R15 is fed through R7 and the rf filter to the input of the modulator, by way of temperature com-

pensation network R80, R81, R82, and RT1. When S1 is in the X5 position, the audio voltage is applied to the modulator input through a constant impedance attenuator consisting of R9, R10, R12, and R8. When S1 is in the X1 position, the audio voltage is applied to the modulator input through a constant impedance attenuator consisting of R11, R13, and R14.

51. Surge Circuit V16 and V17

a. The surge circuit (fig. 17) is a one-kick delay multivibrator that functions once each time the plate supply is energized. Its purpose is to develop a pulse of voltage which, when applied to the control winding of saturable reactor L1 (fig. 10), will overmagnetize the core material and place the inductance of the signal winding at the proper value. This is done to prevent a shift in rf output frequency at the time the signal generator is turned on.

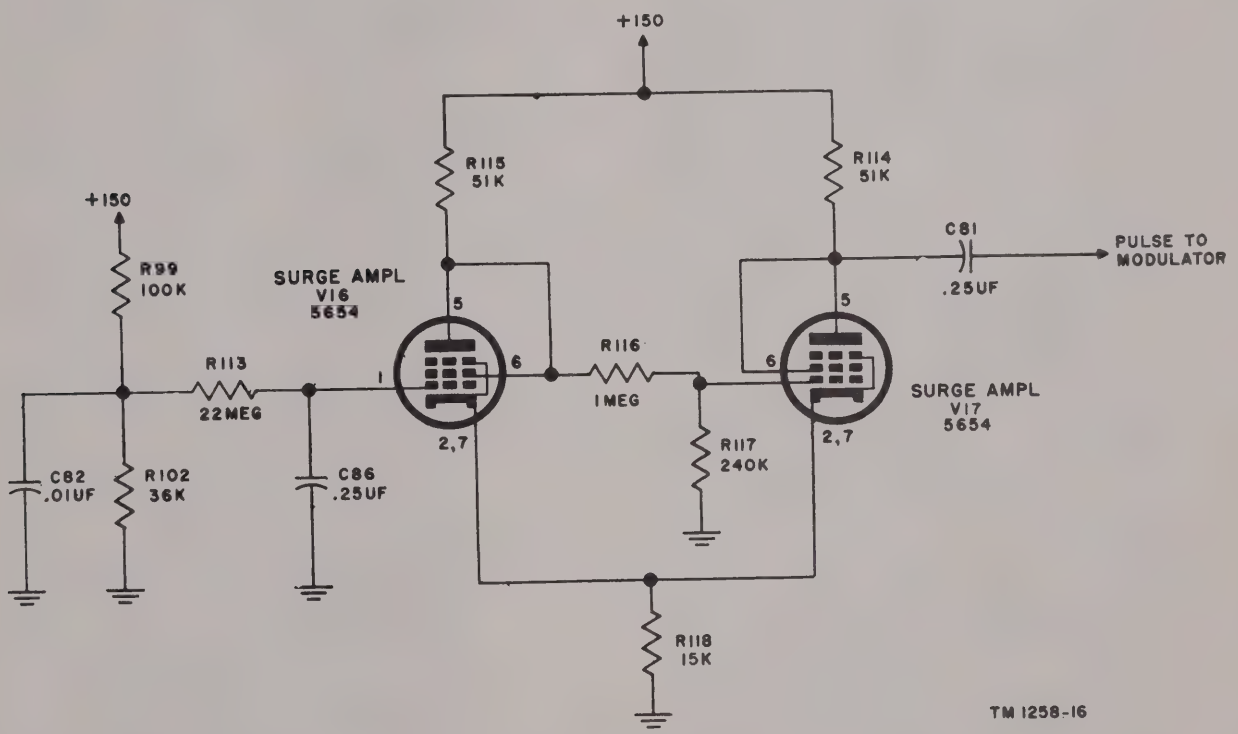


Figure 17. Surge circuit.

b. When power is applied to the signal generator, a potential of +150 volts dc is applied across series resistors R115, R116, and R117. The positive voltage across R117 causes plate current to flow through V17. Plate current flow through cathode resistor R118, which is the common cathode return of both V17 and V16, biases V16 to cutoff, since initially its grid is at ground potential until C86 becomes charged. Capacitor C86 charges slowly through R113 to the positive voltage present across R102. The long time constant of the series combination produces a time delay of several seconds before the voltage across C86 reaches a value that raises the grid potential of V16 above the cutoff value. When V16 conducts, its plate voltage drops; this results in a decrease in the positive potential across R117. A decrease in the positive grid voltage reduces current flow through V17 and causes its plate voltage to rise. At the same time, positive bias potential across R118 is reduced, current flow through V16 is increased, and its plate voltage again is decreased. The plate current of V16 quickly reaches saturation and drops the bias across R117 to below the cutoff value for V17. The sharp voltage rise at the plate of V17, as the plate current is reduced to zero, is fed as a positive pulse through capacitor C81 and resistor R79 (fig. 10) to the grid of modulator amplifier V10. The surge multivibrator circuit remains with V17 at cutoff and V16 conducting heavily until the plate supply is turned off. Capacitor C86 then discharges through R113 and R102, and the cycle then is ready to be repeated.

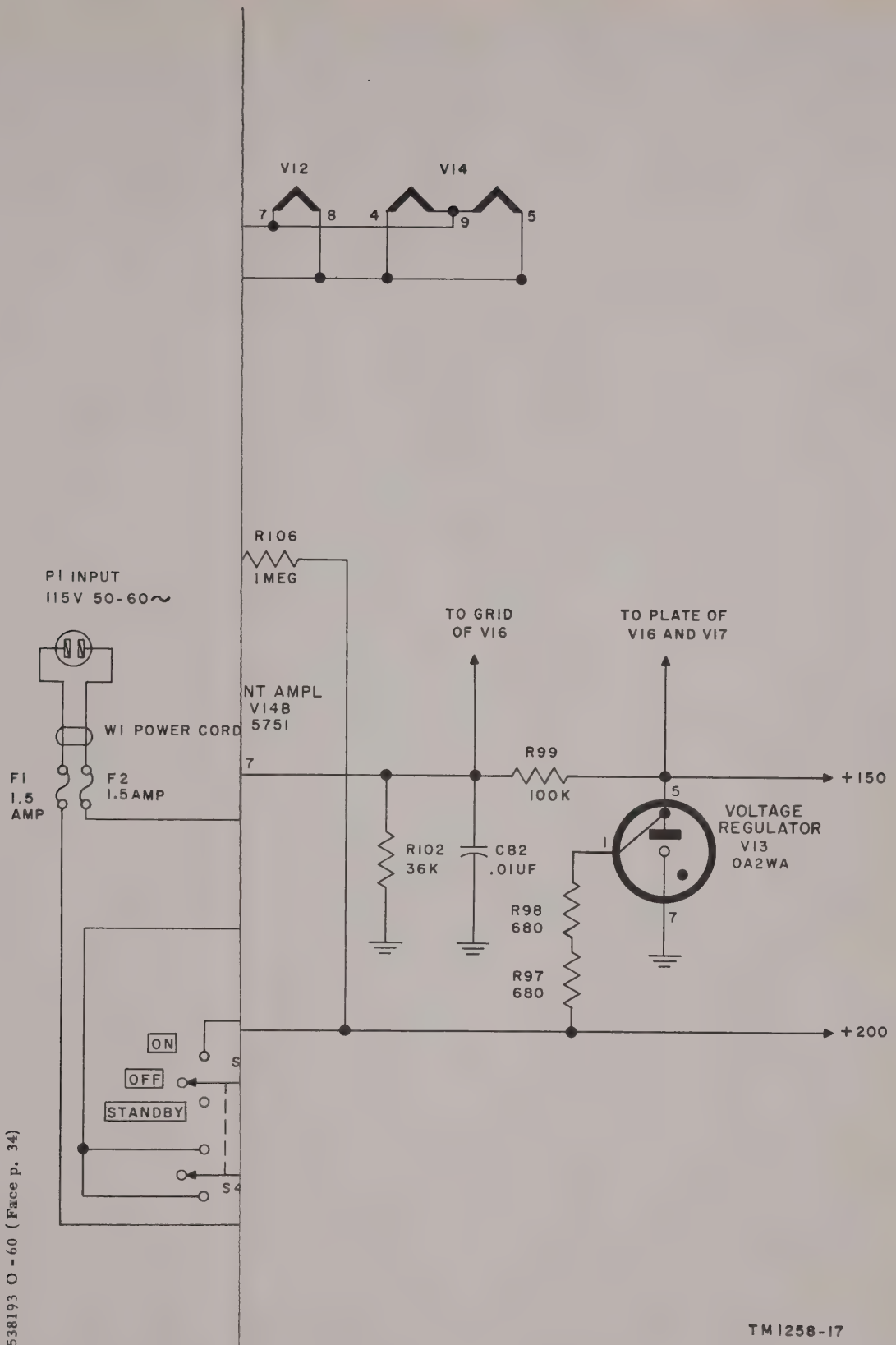
52. Power Supply V12, V13, V14, and V15, and Filter Assembly

a. Power Supply. The power supply (fig. 18) furnishes a regulated 150 volts dc to V5, V10, V16, and V17, and a regulated 200 volts dc to the remaining stages. Power for the indicator lamps and tube heaters, with the exception of the heaters in the surge and rectifier circuits, is furnished from terminals 8 and 9 of power transformer T1. The voltage across terminals 10 and 11 furnishes tube heater power for the surge circuit. The rectifier heater is supplied by terminals 6 and 7.

(1) Power from a 115-volt, 50- to 60-cps source is fed through power plug P1 and cable W1 to the primary winding of power transformer T1, through 1.5-ampere fuses F1 and F2, and POWER switch S4. Switch S4 is a three-position switch which connects the primary winding of T1 to 115 volts alternating current in the ON and STANDBY positions and disconnects the primary in the OFF position. The 700-volt center-tapped secondary winding of T1 supplies plate voltage to full-wave rectifier V15. The center tap of the winding is connected to ground through POWER switch S4 when the switch is in the ON position, and is disconnected in the STANDBY and OFF positions. With switch S4 in the ON position, the rectifier and filter develop a positive 400-volt dc output. The filter is composed of C85, R90, and C84. Resistors R110 and R111 form a bleeder circuit across the input of the filter.

(2) The dc output voltage of the rectifier circuit is regulated by V12, V13, and V14. Regulator tube V12 acts as the variable control-resistance between the resistance-capacitance output filter and the +200-volt bus. The bias of V12 is controlled by the plate current of V14A. The bias of V14A is dependent on the plate current of V14B. Control amplifier V14B is biased by the voltage drop across R102 which is stabilized by glow discharge tube V13, but the cathode bias of V14B is dependent upon the actual voltage at the +200-volt line. A rise in the voltage at the +200-volt line increases the voltage drop along the bleeder network consisting of R103, R104, and R105. The increased voltage drop across R105 increases the positive cathode bias of V14B, thereby reducing its plate current. The reduction in the plate current of V14B results in a reduction in the voltage across plate resistor R106, which is also part of the grid return of V14A. A rise in the positive voltage at the plate V14B reduces the negative bias on the grid of V14A and increases plate current flow through it with a consequent increase in the voltage drop across plate resistor R96. An increase in voltage across R96 increases the negative bias on the control grids of V12 and increases the plate resistance of V12. The increased plate resistance increases the voltage drop across V12, and maintains the voltage at the +200-volt bus practically constant. A decrease in voltage at the +200-volt line reduces the voltage drop across V12. Resistor R91 introduces a small out-of-phase ripple component to improve filtering efficiency. Potentiometer R105 (+200 adjust) is adjusted to provide a 200-volt output at the 200-volt bus. Voltage regulator V13 in series with R97 and R98 is connected between the 200-volt bus and ground. The firing potential of voltage regulator OA2 is 150 volts which appears between pin 5, the anode of the OA2 and ground. Any change in voltage or current will cause the resistance of the voltage regulator tube to change, thereby maintaining a 150-volt output. Resistors R97 and R98 are current limiting resistors, R99 and R102 form a voltage divider, and C82 decouples the voltage regulator from the grid of V16.

b. Filter Assembly (figs. 33 and 44). The filter assembly contains three double pi inductance-capacitance sections that decouple the various stages of the generator from the power supply and



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52. Power Supply V12, V13, V14, and V15, and Filter Assembly

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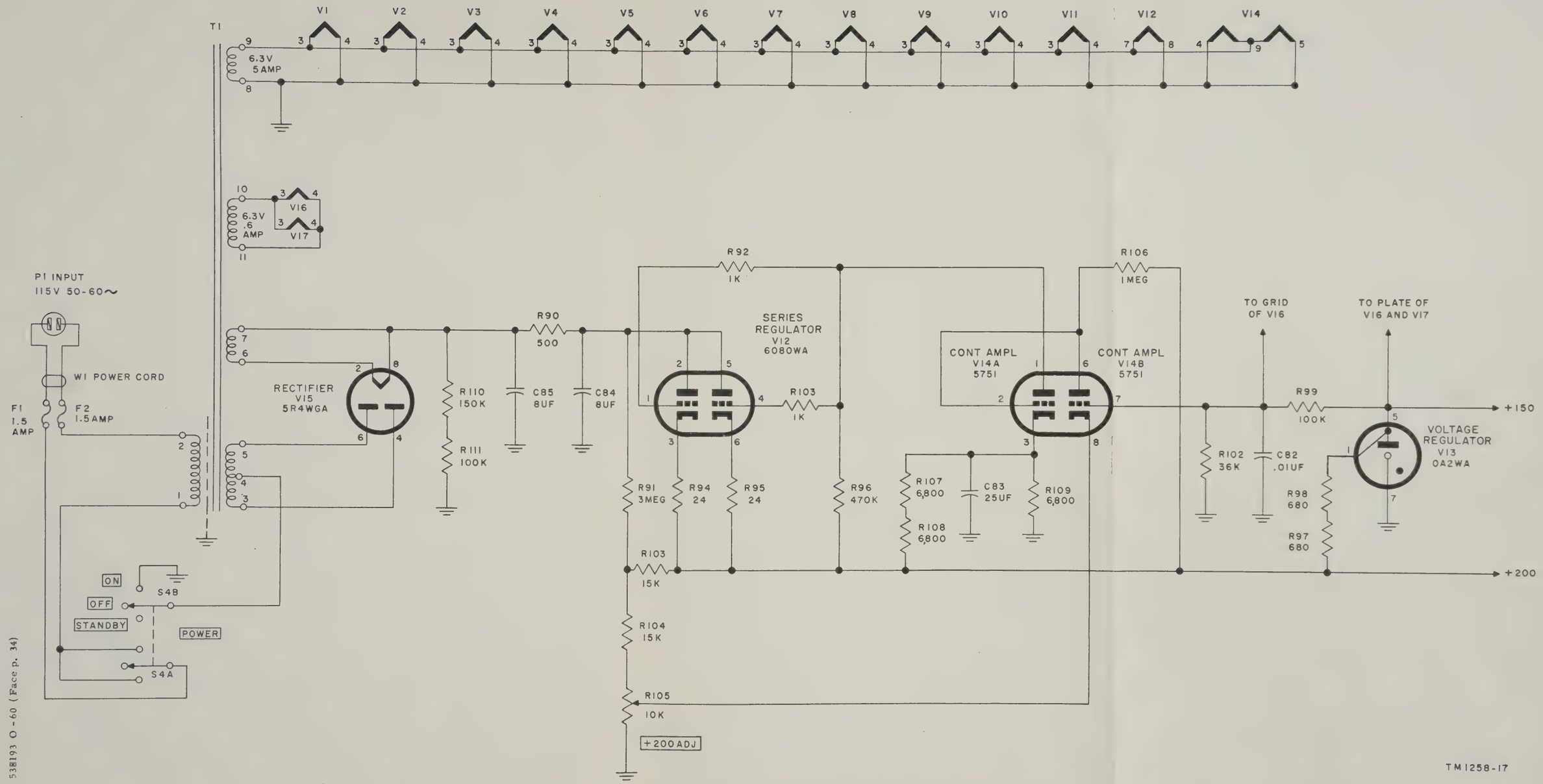


Figure 18. Power supply circuit.

each other. The decoupling or isolating action prevents rf from feeding into the B plus lines. The filter section consisting of L4, L5, L9, and L10 in conjunction with C55, C58, C56, C59, C57, and C60 keeps rf currents originating in the rf oscillator stages from feeding back into the power supply. The surge amplifier is decoupled from the remainder of the generator by the filter consisting of L6, L7, L11, and L12 in conjunction with C61, C64, C62, C66, C63, and C65. Filter section L8, and L13 with C67, C68, and C70, isolates the audio oscillator.

CHAPTER 6

FIELD MAINTENANCE

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing Signal Generator SG–3/U, be extremely careful of exposed high voltages. Dc potentials as high as 400 volts are present. When measuring tube socket or terminal voltages, keep one hand clear of the equipment at all times. Before making resistance measurements or removing defective parts, be sure to disconnect plug P1 from the power receptacle, and be sure to discharge filter capacitors C84 and C85.

53. Troubleshooting Procedures

a. General. The first procedure in servicing a defective signal generator is to isolate the fault to a major circuit or circuits. After isolating the fault to a specific circuit, localize the defect to a specific part or parts. Burned-out resistors, arcing, or shorted transformers can be located by sight or smell. The majority of part failures may be localized by making voltage and resistance measurements.

b. Localization of Defects. If proper results are not obtained when testing or alining a receiver with Signal Generator SG–3/U, the signal generator may be at fault. To check the generator, make a careful visual inspection and operational test ((1) and (2) below) to sectionalize and localize the trouble. If the defect is not immediately apparent, proceed with the troubleshooting procedures outlined in (3) through (6) below.

(1) *Visual inspection.* A careful visual inspection with the equipment in an operating or nonoperating state often will provide a clue as to the exact location of an existing defect. Even with the signal generator in proper operating conditions, a periodic visual inspection will aid in forestalling equipment failures. Refer to paragraph 37 for visual inspection procedure.

(2) *Operational test.* The operational test is used to check all functions of the signal generator. When making this test, manipulate all of the front-panel controls and switches and see that all controls operate smoothly, both mechanically and electrically. Connect the output of the signal generator to a reliable fm receiver. Check the frequency output of the signal generator on all three bands, at different output levels, at all modulation frequencies, and at different deviation levels. Refer to the equipment performance check list (par. 39) for probable troubles and their locations.

(3) *Tube test.* Most troubles encountered in electronic equipment can be attributed directly to defective vacuum tubes. Before proceeding with a point-by-point check of the signal generator, test the vacuum tubes associated with the suspected faulty circuit.

Caution: To prevent misalinement of the signal generator, be sure to replace each tested tube in its original socket.

(4) *Troubleshooting chart.* The troubleshooting chart (par. 59) will aid greatly in localizing the trouble.

(5) *Power supply test.* If the preceding tests fail to localize the trouble, check the power supply for proper operation in accordance with procedures outlined in paragraph 58.

(6) *Intermittent trouble.* In all of these tests, the possibility of intermittent faults should not be overlooked. If present, this type of trouble sometimes can be detected by tapping or jarring the unit.

If a small rubber mallet or some insulated nonmetallic instrument is used to tap tubes or individual components, be careful not to disrupt the position of the part being tapped and other parts within the signal generator.

54. Troubleshooting Data

Always check the circuit label, since the schematic diagram in the manual may not include circuit changes made during equipment production. Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following troubleshooting data.

Fig. No.	Title
4	Signal Generator SG–3/U, tube location.
19	Signal Generator SG–3/U, top view interior.
20	Signal Generator SG–3/U, bottom view interior.
21	Rf assembly, left side view.
22	Rf assembly, top view.
23	Mounting plate for tuning capacitor.
24	Typical tuning capacitor assembly.
25	Rf assembly, bottom view.
33	Filter assembly, interior view.
34	Audio oscillator and deviation indicator assembly, bottom view.
35	Audio oscillator and deviation indicator assembly, top view.
36	Power supply section, bottom view.
37	Voltage, resistance, and parts location of terminal boards.
38	Tube-socket voltage and resistance diagram.
42	Resistor color code.
43	Capacitor color code.
44	Signal Generator SG–3/U, schematic diagram.

55. Test Equipment Required for Troubleshooting

The items of test equipment required for troubleshooting Signal Generator AN/URM–70 are listed below. Manuals associated with each item also are listed.

Test equipment	Manual or stock number
Electronic Multimeter TS–505/U	TM 11–5511
Multimeter TS–352/U	TM 11–5527
Electron Tube Test Set TV–2/U	TM 11–2661
Frequency Meter TS–174B/U	TM 11–5044
Frequency Meter TS–175B/U	TM 11–5050
Panoramic Indicator IP–173/U	TM 11–5086
Frequency Meter FR–67/U	TM 11–2698
Signal Generator TS–497A/URR	TM 11–5030A
Radio Receiver R–274/FRR	TM 11–897
Signal Generator SG–71/FCC	TM 11–5088
Barretter bridge	Measurements Model 202B
Spectrum Analyzer TS–723/U	3F 1722–5.4
Fixed attenuator	S/N 2 Z 394.85
Variac CN–16	S/N 2 Z 9944–16
Tuning wand	S/N 6 R 38490

56. General Precautions

a. When the unit has been operating for some time, the electron tubes are hot enough to cause a serious burn if they are not handled properly. When removing tubes for test or replacement, use an appropriate tube puller or dry cloth to protect the fingers.

b. When probing inside the signal generator, be careful not to disturb the position of, or damage, any part.

c. Careless removal or replacement of parts often creates additional faults.

d. If it is necessary to remove or replace an assembly or part which is secured mechanically, be sure to install all screws, nuts, bolts, flat washers, lockwashers, spacers, spacer posts, etc., that were removed. Note the following points:

(1) Before a part is unsoldered, note its exact position. Install the part in its original position. If a part has a number of leads connected to it, tag each lead for positive identification to facilitate and assure correct installation.

(2) Be careful not to twist or kink other leads by pulling or pushing them out of the way.

(3) If it is necessary to unlace a wiring harness to remove a defective wire, relace the wiring harness after replacement.
(4) Do not use a large iron to unsolder small capacitors and resistors. These parts may be damaged permanently by the application of an excessive amount of heat.
(5) Do not permit drops of solder to fall into the set; they may cause short circuits.
(6) It is very important to make well-soldered joints, since a poorly soldered joint may cause troubles difficult to find.
(7) When a part is removed from the high-frequency (hf) circuits, it must be replaced by a part with identical physical and electrical properties. A part which has the same electrical value, but differs in physical size, may cause trouble in hf circuits. Give particular attention to proper grounding when replacing a part. In all cases, ground the part at the same point at which it was grounded previously. Failure to observe these precautions may result in decreased output, misalinement, or spurious oscillations.
(8) Do not disturb the settings of the various trimmer capacitors, tuned inductances, or adjustment potentiometers, unless it has been definitely established that a misadjustment is the cause of trouble.
(9) After replacing a part in a circuit, check the operation and calibration of the circuit or circuits affected in accordance with the procedures given in paragraph 88. Adjust and aline, if necessary.

57. Checking Parts

Many of the parts used in the signal generator are manufactured to close tolerances. For proper operation of the signal generator, it is necessary that these parts remain within the required exacting values. Therefore, the ordinary means of checking parts will not suffice in some instances.

a. If tolerances are exacting, use a precision bridge to check capacitors and resistors.

b. A good indication, using the best tube tester available, is not always conclusive evidence that a tube is good. At the high frequencies present in the signal generator, direct tube substitution in the rf circuits is the only effective means of determining whether a tube is functioning properly. Sometimes it is necessary to substitute a number of tubes before one is found that will function satisfactorily.

58. Power Supply Circuit Failures

a. Since the operation of the entire signal generator is dependent upon the proper functioning of the power supply, it is wise to check the operation of this circuit first before proceeding with the more complicated and time consuming procedures. A heavy overload on the power supply probably will cause F1 or F2 to blow. Repeated fuse failures indicate that trouble exists in the power supply or in the circuits fed by the power supply. If the signal generator is operating satisfactorily over an extended period of time, an occasional fuse failure should not be viewed with alarm as it may be the result of a momentary surge. Check the power supply in accordance with the following instructions:

b. If the fuses are found to be intact, measure the dc voltage at pin 5 of tube V12 for a reading of +400 volts. Also, check for +200 volts dc at pin 6 of V12, and +150 volts dc at pin 5 of V13.

(1) If the voltages measured differ appreciably from the specified values, check and, if necessary, replace V12, V13, V14, or V15.
(2) If the trouble is not corrected by tube replacement, make voltage and resistance measurements of the entire power supply circuit.
(3) It is entirely possible that the defect in the remaining circuitry of the signal generator is the cause of the low- or high-voltage output of the power supply. Check for burned or overheated resistors in other parts of the unit, and make voltage and resistance measurements of all tube sockets and terminal boards.
(4) A fuse failure along with a malfunctioning signal generator is evidence that trouble exists in the power supply or B+ circuits. Starting with the power supply circuits, make a complete resistance check of all the circuits in the signal generator (figs. 37 and 38).

59. Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the signal generator. Listed in the chart are abnormal indications which a repairman may encounter while making a few simple tests.

Symptom	Probable trouble	Correction
1. Line cord connected to power source and POWER switch is in STANDBY position. The 50–100, the 100–200, and the 200–400 indicator lamps fail to light when the FREQ. RANGE-MC switch is rotated to these positions.	Blown fuse F1 and/or F2	Replace blown fuse. If fuse blows again, check the primary winding and all filament windings of T1. Check for a shorted rf bypass capacitor in the filament circuits. Check for a filament-to-cathode short in the tubes whose cathodes are grounded directly.
	Open filament winding (terminals 8 and 9) or primary winding (terminals 1 and 2) of T1.	Replace T1.
	Defective POWER switch or power cable.	Replace S4 or power cable.
2. POWER switch in STANDBY position. One or two indicator lamps fail to light when the FREQ. RANGE-MC switch is rotated through its three positions.	Defective indicator lamp I 1, I 2, or I 3.	Replace the defective lamp.
3. Fuse F1 and/or F2 blows when. POWER switch is set to ON position.	Shorted rectifier tube V15	Replace V15.
	Shorted filter capacitor C84 or C85	Replace C84 or C85.
	Defective transformer	Replace T1.
	A short in any of the dc circuits in the signal generator.	Make resistance measurements at the tube socket of all tubes in the signal generator.
4. Power switch in ON position. OUTPUT meter is at center scale and there is no rf output on all three positions of the FREQ. RANGE-MC switch.	Defective rectifier tube V15 or regulator tube V12.	Replace V15 or V12.
	Open high-voltage winding (terminals 3, 4, and 5) on T1.	Replace T1.
	Defective POWER switch S4	Replace S4.
5. MODULATION switch in the OFF position. Low, or zero, rf output on all three ranges of the FREQ. RANGE-MC switch.	Defective oscillator tube V5, first doubler V6, or rf amplifier V7.	Substitute tubes known to be good, first for V5, then V6, and finally for V7.
	A defective component in the circuitry of the above mentioned tubes.	Make voltage and resistance measurements at the tube sockets of V5, V6, and V7.
6. MODULATION switch in OFF position. Low, or zero, rf output on the 100–200 and 200–400 mc positions of the FREQ. RANGE-MC switch.	Defective second doubler V8	Substitute tubes known to be good for V8.
	A defective component in the circuitry of V8.	Make tube-socket voltage and resistance measurements on V8.
7. MODULATION switch in OFF position. Low, or zero, rf output on the 200–400 mc position of the FREQ. RANGE-MC switch	Defective third doubler tube V9	Substitute tubes known to be good for V9.
	A defective component in the circuitry of V9.	Make voltage and resistance measurements at the tube socket of V9.
	Defective attenuator	Replace attenuator.
8. MODULATION switch in OFF position. Low, or zero, rf output on one of the three positions of the FREQ. RANGE-MC switch.	S5 defective	Replace S5.
	Attenuator connecting cable open or shorted.	Replace cable.
	Defective attenuator	Replace attenuator.
9. Rf output is equal to 100,000 microvolts. OUTPUT meter does not indicate center scale.	OUTPUT TEMPERATURE COMPENSATION potentiometer R129 and/or OUTPUT CAL potentiometer R130 misadjusted.	Adjust R129 and R130.
	Defective bolometer RT4 or defective component in the bolometer bridge circuit.	Check parts in bolometer bridge circuit. Replace where necessary. ***Caution:*** Do not use ohmmeter on RT4.
	Defective OUTPUT meter	Replace M2.

Symptom	Probable trouble	Correction
10. Output frequency does not coincide with FREQ. IN MEGACYCLES dial setting.	Defective capacitor or inductor L2 in the frequency determining elements of oscillator V5.	Check parts with appropriate test equipment. Replace where necessary.
	Reactor L1 defective	Replace L1.
	Defective R100, RT2, R66, R65, or C52.	Replace defective component.
	Rf oscillator V5 misalined	Check alinement of oscillator.
11. No audio modulation in output, and KILOCYCLES DEVIATION meter does not indicate in the 1000~, 1600~, and 20KC positions of the MODULATION switch.	Defective audio oscillator V3 or amplifier V4.	Check and, if necessary, replace V3 and V4.
	Defective E1	Replace E1.
	A defective part in the circuitry of V3 or V4.	Make a voltage and resistance measurement at the tube sockets of V3 and V4.
	Open arm on DEVIATION control R15.	Replace R15.
	Open contact on S2	Replace S2.
12. No audio modulation in output, and KILOCYCLES DEVIATION meter does not indicate on one of the three modulation positions of the MODULATION switch.	Defective contact in a particular position of the MODULATION switch.	Check contacts on both sections of S2.
	Defective part connected to a particular contact of S2.	In 1000 ~ position, check and, if necessary, replace R23, R26, or C8.
		In 1600 ~ position, check and, if necessary, replace R22, R25, or C7.
		In 20KC position, check and, if necessary, replace R21, R24, or C6.
13. KILOCYCLES DEVIATION meter indicates correctly on all positions of MODULATION switch. There is no audio modulation in the output on one position of the DEV MULT switch.	Defective contact on S1	Replace S1.
	Defective resistor in DEV MULT attenuator networks.	Replace defective resistor.
14. Audio modulation and deviation normal on all ranges of MODULATION switch. KILOCYCLES DEVIATION meter does not indicate at all.	Defective amplifier V1 or rectifier V2.	Check and, if necessary, replace V1 or V2.
	Defective part in the circuitry of V1 or V2.	Make a voltage and resistance measurement at the tube sockets of V1 and V2.
	Defective KILOCYCLES DEVIATION meter.	Replaces M1.
15. KILOCYCLES DEVIATION meter indicates correctly on all positions of MODULATION switch. There is no audio modulation in the output, very little deviation or excessive modulation distortion.	Tube V10 or V11 in modulator circuit defective.	Check and, if necessary, replace V10 or V11.
	A component in the circuitry of V10 or V11 is defective.	Make a voltage and resistance measurement at the tube sockets of V10 and V11.
	C81 shorted	Replace C81.
16. Modulation frequency in output does not coincide with setting of MODULATION switch on all three positions. Excessive distortion. EXT. MOD. produces correct output.	Defective V3 or V4	Replace defective part.
	R27 misadjusted. E1 defective	Realine audio oscillator.
17. Modulation frequency in output does not coincide with setting of MODULATION switch on one of the three positions.	In 1000 ~ position, defective R23 or R26.	Replace R23 or R26.
	Misadjusted C8	Realine C8.
	In 1600 ~ position, defective R22 or R25.	Replace R22 and R25.
	Misadjusted C7	Realine C7.
	In 20KC position, defective R21 or R24.	Replace R21 or R24.
	Misadjusted C6	Realine C6.

Symptom	Probable trouble	Correction
18. Frequency deviation in output is correct but does not coincide with indication on KILOCYCLES DEVIATION meter in all positions of the DEV MULT switch.	DEV CAL potentiometer R6 misadjusted.	Adjust R6 and check adjustment of R8 and R13.
	Defective V1 or V2	Check and, if necessary, replace V1 or V2.
	A defective part in the circuitry of V1 or V2.	Make a voltage and resistance measurement at the tube sockets of V1 and V2.
19. Frequency deviation in output is correct and coincides with indication on KILOCYCLES DEVIATION meter in X10 position of DEV MULT switch, but does not coincide with meter reading in X1 or X5 position.	X1 ADJ potentiometer R13 misadjusted.	Readjust R13.
	X5 ADJ potentiometer R8 misadjusted.	Readjust R8.
	X1 position, defective R11, R13, or R14.	Replace defective part.
	In X5 position, defective R8, R9, R10, or R12.	Replace defective part.
20. For a given setting of the DEVIATION control, the output frequency deviation varies as the output carrier frequency is varied through the tuning range.	DEV COMP potentiometer R65 is misadjusted.	Adjust R65.
	A defective part in the circuitry of V10 or V11.	Make a voltage and resistance measurement at the tube sockets of V10 and V11.
	R66 defective	Replace R66.
21. Modulated rf output is distorted	Defective tubes V3, V4, V10, and V11.	Substitute tubes known to be good.
	A defect in the circuitry of the above mentioned tubes.	Make voltage and resistance measurements at the tube sockets of the above tubes.
	BIAS ADJ potentiometer R100 misadjusted.	Adjust R100.
	R27 misadjusted	Adjust R27.
	E1 defective	Replace E1.

Section II. REPAIRS

60. Replacement of Parts

a. Most of the parts in Signal Generator SG–3/U are readily accessible and can be replaced easily. Tag wires to prevent wrong connections whenever replacement requires the temporary removal of wiring.

b. To gain access to the interior of the signal generator, the left side, top, and bottom covers must be removed. Remove the left side cover by loosening the six captive screws which secure it to the frame. After removing the left side cover, the top and bottom covers may be removed by sliding them out of position.

c. To gain access to the rf assembly, pull off the outer and inner rf shields. This permits access to all tube-socket pins. To gain access to the components in the oscillator and first doubler, remove the cover plate from the rf assembly (figs. 19 and 20) by removing the 25 screws (fig. 21) which secure the cover plate to the rf assembly.

61. Disassembly and Assembly of Rf Assembly

a. To remove the rf assembly, proceed as follows:

(1) On the dial cover, remove the dial lock, TUNING dial and knob, and 200–400MC TRIMMER knob (fig. 5).

(2) Remove the dial cover by removing the four screws which secure it to the front panel.

(3) Remove the hairline window which is held in place over the FREQ. IN MEGACYCLES dial by two screws.

(4) Remove the FREQ. IN MEGACYCLES dial by removing the three screws which secure it to the hub.

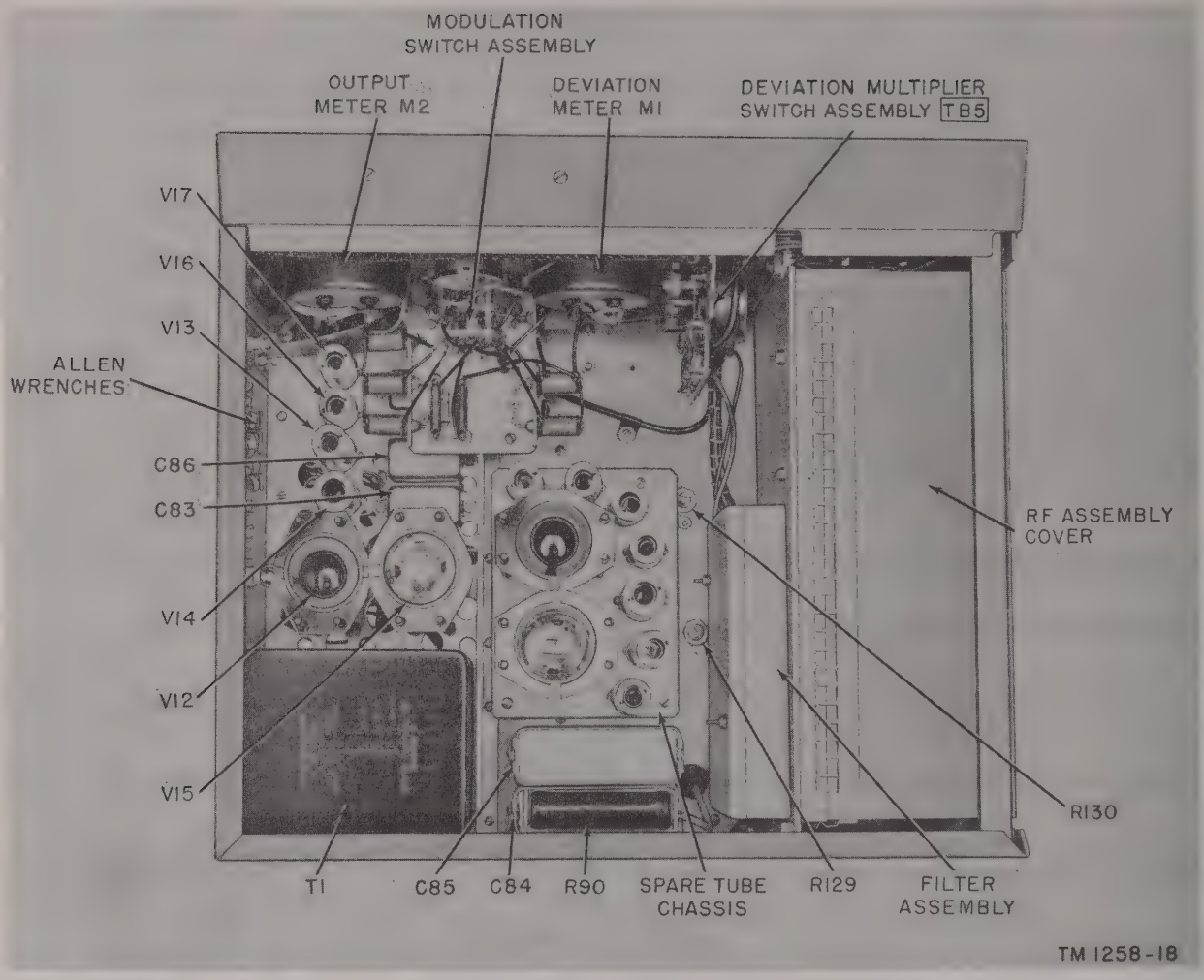


Figure 19. Signal Generator SG–3/U, top view of interior.

(5) Loosen the four setscrews in the hub to which the FREQ. IN MEGACYCLES dial was secured. (There are two setscrews in each hole.) Remove the hub.

(6) Loosen the two setscrews in the hub of the 200–400MC TRIMMER and remove the plastic shaft.

(7) Unsolder the leads to C55, C58, C61, C64, and C67 (fig. 21) on the rf assembly.

(8) Remove the seven nuts (figs. 21 and 25) which secure the oscillator subplate to the chassis and remove the rf assembly.

b. To replace the rf assembly, proceed as follows:

(1) Position the rf assembly and replace the seven nuts which secure the oscillator subplate to the chassis.

(2) On the rf assembly, solder the leads to C55, C58, C61, C64, and C67 (fig. 21).

(3) Insert the plastic shaft and tighten the two setscrews in the hub of the 200–400MC TRIMMER capacitor.

(4) Position and then secure the hub of the FREQ. IN MEGACYCLES dial by tightening the two setscrews, and two locking setscrews.

(5) Position, then secure the FREQ. IN MEGACYCLES dial to the hub by replacing the three screws previously removed.

Note. When the dial is replaced, the index mark on the dial must coincide with the index mark on the hub.

(6) Position the hairline window. Replace the two screws that secure the window in

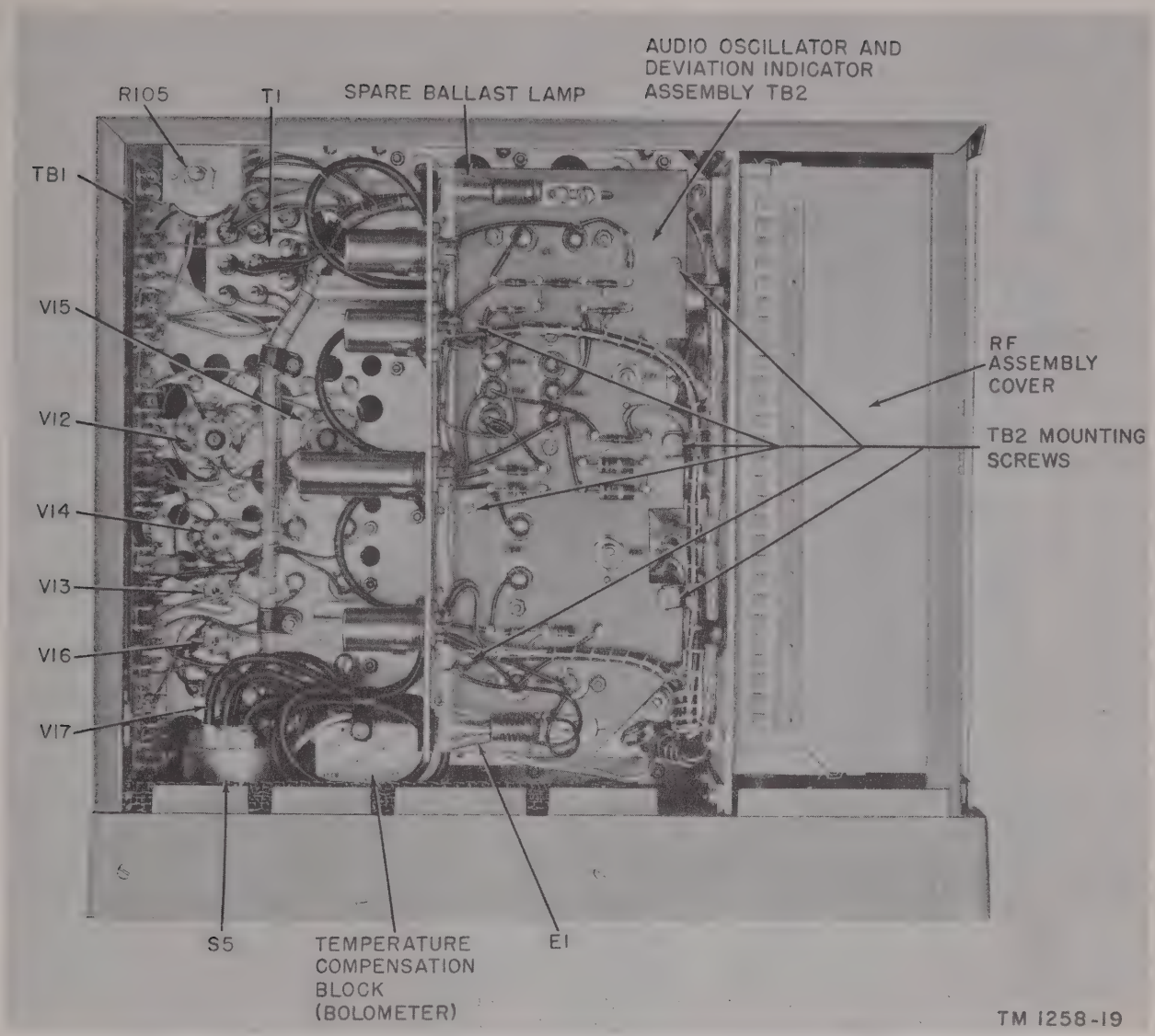


Figure 20. Signal Generator SG–3/U, bottom view of interior.

place over the FREQ. IN MEGACYCLES dial.

(7) Position the dial cover. Replace the four screws which secure the cover to the front panel.

(8) Replace the dial lock, TUNING dial and knob, and the 200–400MC TRIMMER knob.

62. Disassembly and Assembly of Capacitor Assembly C16

a. To remove tuning capacitor assembly C16 (fig. 22) from the rf assembly, proceed as follows:

(1) Remove the rf assembly by following the instructions given in paragraph 61.

(2) Unsolder the leads leading to C21, C15, the plate lead of V5, and the three center tap leads of L2 (fig. 22).

(3) Remove the four screws that secure the base of the assembly to its mounting plate (fig. 23).

(4) Remove the C16 capacitor assembly.

Note. Capacitors C18 and C19 and coil L2 are components of the tuning capacitor assembly C16 (figs. 21 and 22).

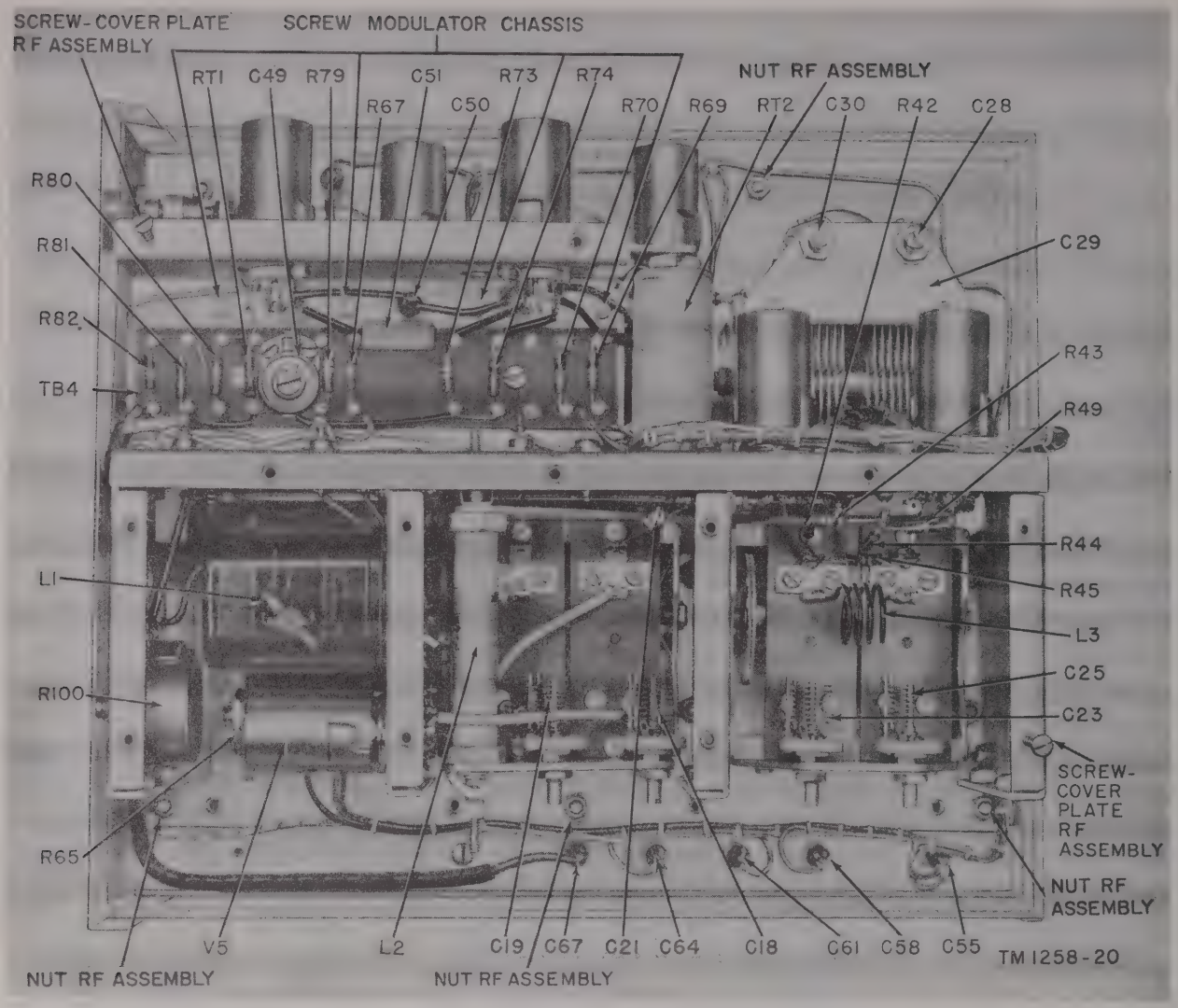


Figure 21. Rf assembly, left side view.

b. To replace tuning capacitor assembly C16 (fig. 22), proceed as follows:

(1) Position the assembly and secure it to the mounting plate by replacing the four screws previously removed.

(2) Solder the leads leading to C21, C15, the plate lead of V5, and the three center tap leads of L2 (fig. 22).

(3) Replace the rf assembly as described in paragraph 61.

63. Disassembly and Assembly of Capacitor Assembly C24

a. To remove tuning capacitor assembly C24 (fig. 22) from the rf assembly, proceed as follows:

(1) Remove the rf assembly by following the instructions given in paragraph 61.

(2) Unsolder the leads connecting R42, R44, and R46 (fig. 22) to the capacitor assembly.

(3) Remove the four screws that secure the base of the assembly to its mounting plate (fig. 23).

(4) Remove the assembly.

Note. Coil L3 and capacitors C25 and C23 (figs. 21 and 22) and the split gears (fig. 22) are all components of the tuning capacitor assembly C24.

b. To replace tuning capacitor assembly C24 (fig. 22), proceed as follows:

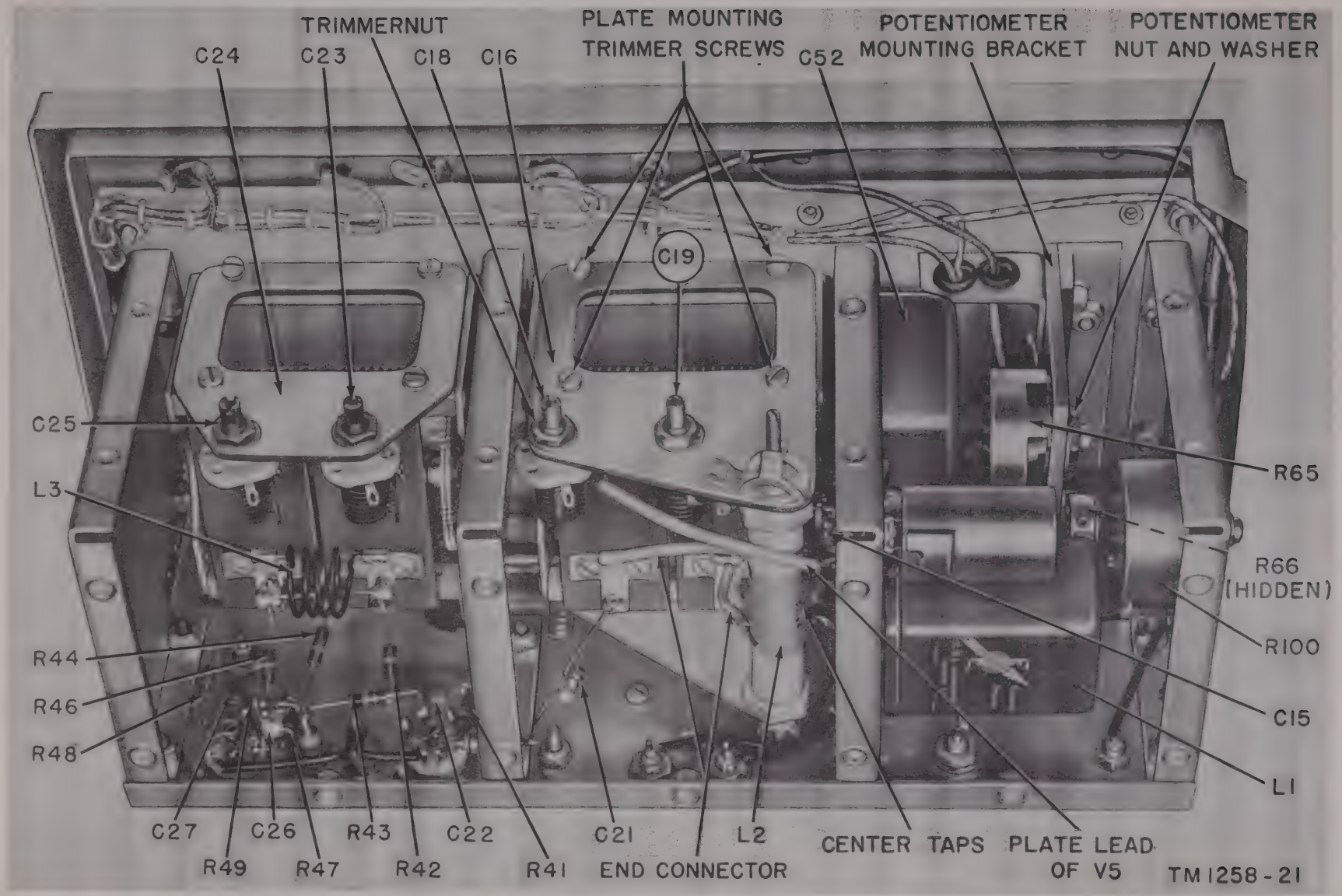


Figure 22. Rf assembly, top view.

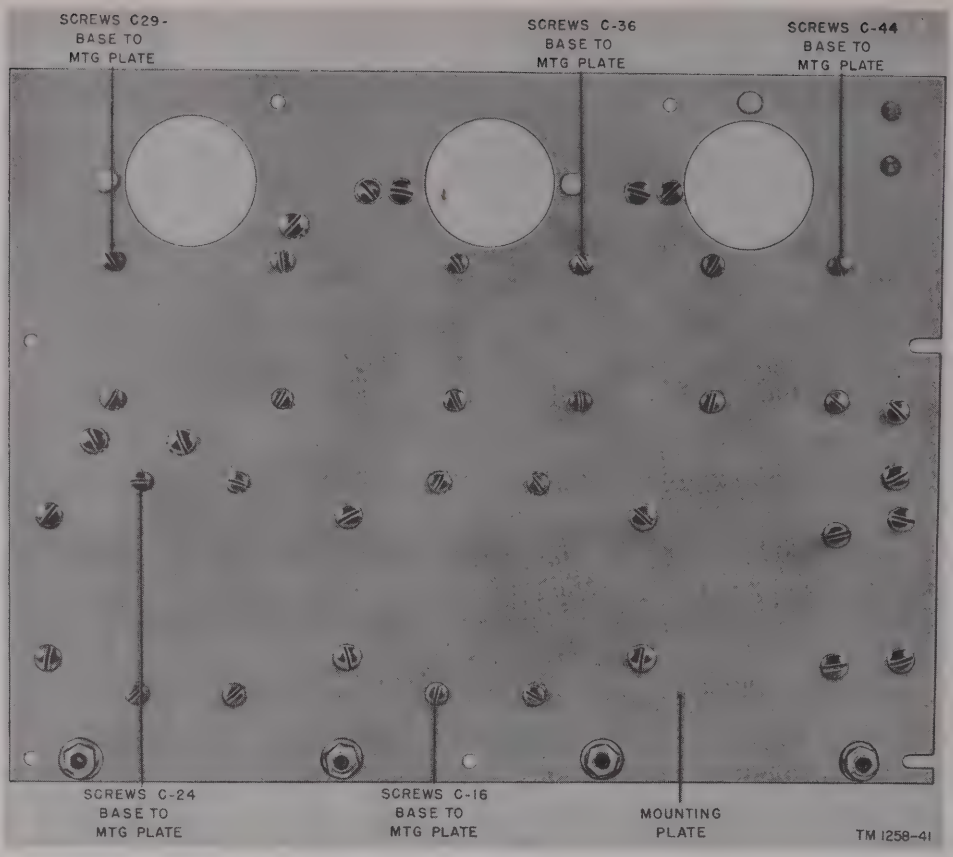


Figure 23. Mounting plate.

(1) Position the assembly and secure it to the mounting plate with four screws.
(2) Solder the three leads attached to R42, R44, and R46 (fig. 22).
(3) Replace the rf assembly as described in paragraph 61*b*.

64. Disassembly and Assembly of Capacitor Assembly C44

a. To remove tuning capacitor assembly C44 (fig. 25), remove the rf assembly, and proceed as follows:

(1) Remove RT2 (figs. 21 and 25) . This is accomplished by removing the long screw which passes through the center of RT2 and which secures it to the rf assembly, and by unsoldering the two leads coming off RT2.
(2) Free the modulator chassis (V10 and V11 are mounted on this chassis; see fig. 25) by removing the six screws (fig. 21) which secure it to the rf assembly.

Note. Do not unsolder any connections. The chassis will lift freely and the length of connections allows ample room to continue the removal of C44.

(3) Unsolder the three leads to C45, C46 (fig. 25), and C41.
(4) Remove the seven screws (fig. 23) which hold the capacitor in place.
(5) Remove the assembly.

Note. The split gears, L20 and R63, are components of tuning capacitor assembly C44 (fig. 25).

b. To replace tuning capacitor assembly C44, proceed as follows:

(1) Position and secure the capacitor in place with the seven screws.
(2) Solder the three leads to C45, C46, and C41.
(3) Position, then secure the modulator chassis to the rf assembly with six screws.
(4) Position RT2. Replace the long screw which secures RT2 to the rf assembly. Solder the two leads.

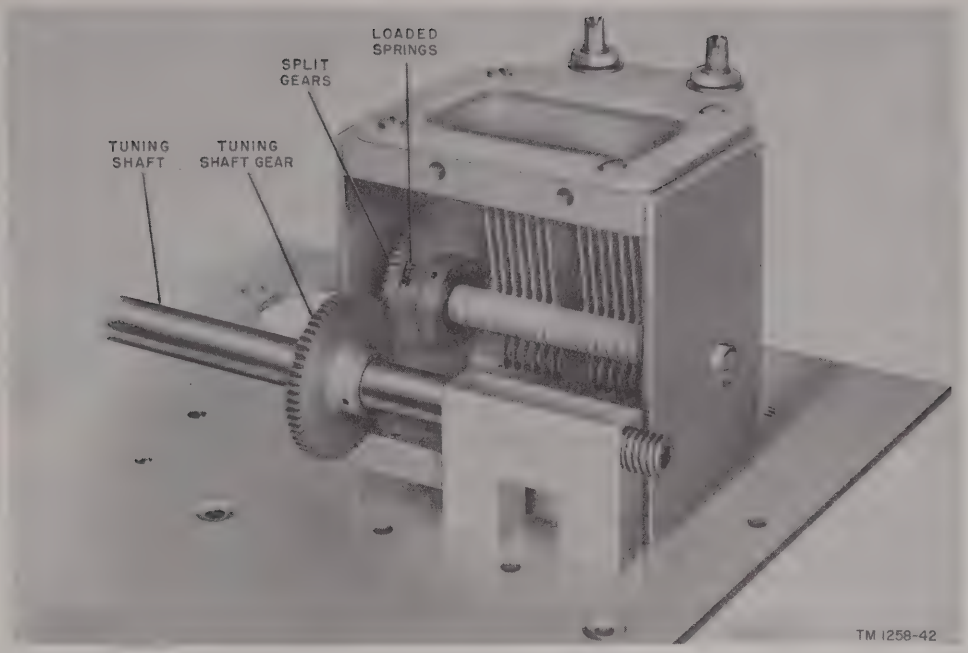


Figure 24. Typical tuning capacitor.

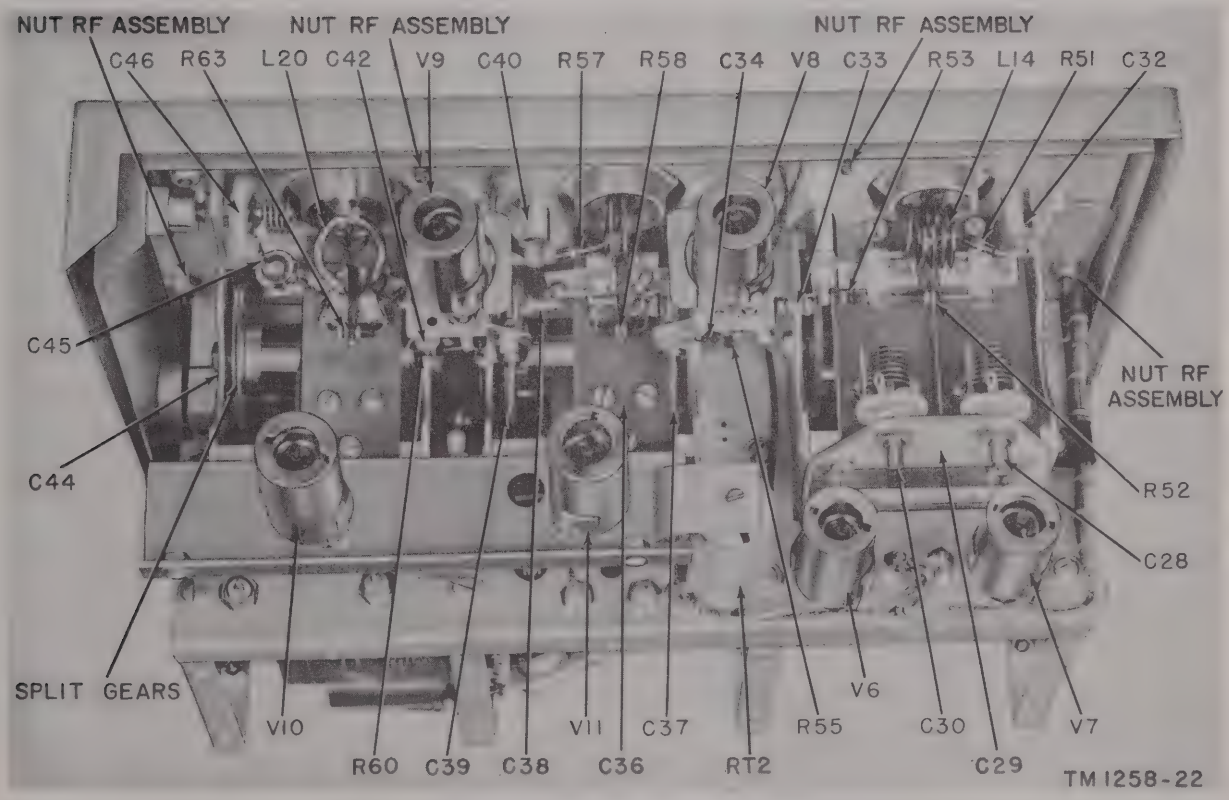


Figure 25. Rf assembly, bottom view.

(5) Replace the rf assembly.

Note. Third doubler V9 is not affected by the removal or replacement of C44 (fig. 25).

65. Disassembly and Assembly of Capacitor C29

a. To remove tuning capacitor C29 (figs. 21 and 25) from the rf assembly, proceed as follows:

(1) Remove tuning capacitor C24 (fig. 22) as outlined in paragraph 63*a*.

(2) Unsolder the leads to R53 and stator lead to C29 (fig. 25).

(3) Remove the eight screws which secure C29 (fig. 23).

(4) Remove the assembly.

Note. Capacitors C28 and C30 and coil L14 and the split gears are components of tuning capacitor assembly C29 (figs. 21 and 25).

b. To replace tuning capacitor C29, proceed as follows:

(1) Position and secure C29 to the rf assembly with the eight screws.

(2) Solder the stator lead and leads to R53.

(3) Replace C24 as outlined in paragraph 63*b*.

66. Disassembly and Assembly of Capacitor C36

a. To remove tuning capacitor C36 (fig. 25) from the rf assembly, proceed as follows:

(1) Remove tuning capacitor C16 as directed in paragraph 62.

(2) Remove RT2 and free the modulator chassis as directed in paragraph 64*a*(1) and (2).

(3) Unsolder the leads to C37, C38, and R57.

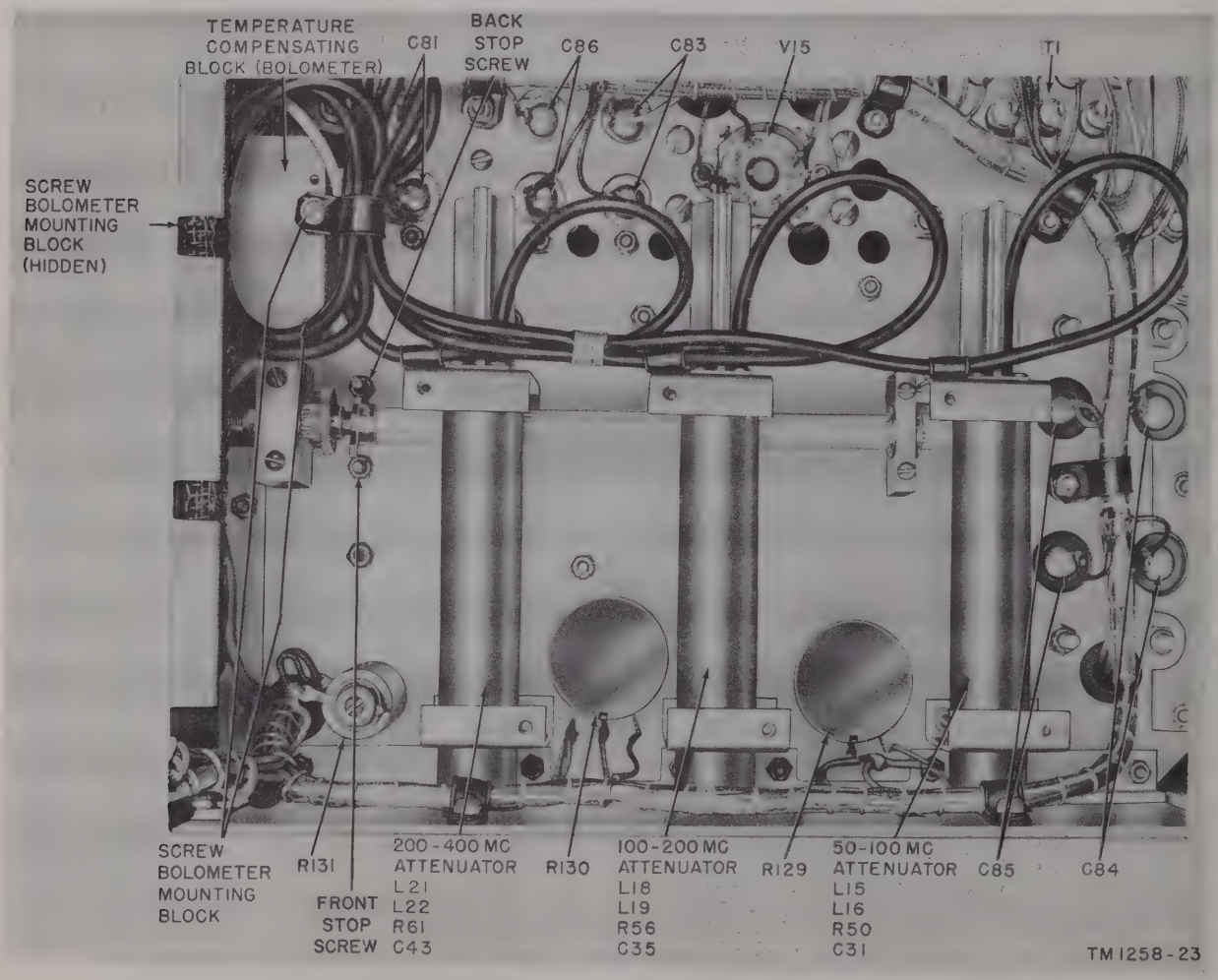


Figure 26. Signal generator, showing attenuators.

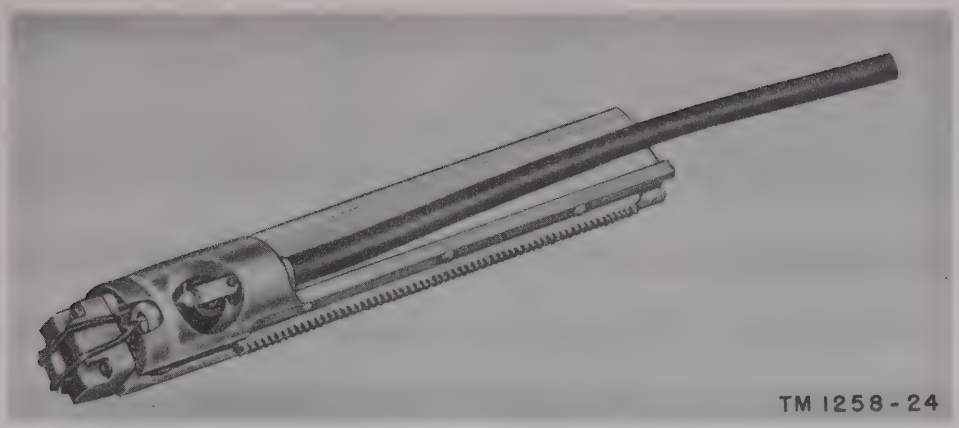


Figure 27. Typical attenuator core.

(4) Remove the seven screws which hold capacitor C36 in place (fig. 23) and remove the capacitor.

Note. Tube V8 (fig. 25) is not affected in the removal or replacement of C36.

b. To replace capacitor C36, proceed as follows:

(1) Position and secure the capacitor with seven screws.
(2) Solder leads to C37, C38, and R57.
(3) Position and replace RT2 and the modulator chassis as outlined in paragraph 64*b*(3) and (4).
(4) Replace tuning capacitor C16 as outlined in paragraph 62.

Note. In replacing any tuning capacitor, preload the spring (fig. 24) in the split gears two and one-half teeth before meshing with the main shaft gears. Gears should mesh as closely as possible without binding. Adjust all rotors so that the plates are fully meshed simultaneously.

67. Disassembly and Assembly of Potentiometer R65 and R66

a. To remove potentiometer R65 or R66 (figs. 21 and 22), proceed as follows:

(1) Remove the rf assembly as described in paragraph 61.
(2) Remove the two screws which secure the potentiometer mounting bracket to the oscillator subplate (fig. 22).
(3) Unsolder the leads and remove the potentiometer mounting bracket (fig. 22).
(4) Back off one nut and remove it and the washer that secure the potentiometer to the mounting bracket.
(5) Remove the potentiometer.

b. To replace the potentiometer, proceed as follows:

(1) Secure the potentiometer to the mounting bracket with one nut and washer.
(2) Solder the leads and secure the potentiometer mounting bracket to the oscillator subplate with two screws.
(3) Replace the rf assembly as described in paragraph 61.

68. Disassembly and Assembly of Attenuators

a. To remove any one of the three attenuators (figs. 26 and 27), proceed as follows:

(1) Remove the six screws which secure the audio oscillator and deviation indicator terminal board TB2 (fig. 20) to its mounting brackets.
(2) Tilt this assembly out of the way; be careful not to damage the wiring harness.
(3) On the front panel (fig. 5), turn the OUTPUT knob to back the attenuators out until a limit stop is reached.
(4) Back off the front stop screw and the back stop screw, and back out the attenuator (fig. 26).

b. To replace the attenuators, proceed as follows:

(1) Slide the attenuators into their respective positions (fig. 26).
(2) Turn the front stop screw to roughly midpoint. Adjust the front stop screw and slip the gears on the attenuators until the attenuator pick-up coils approach

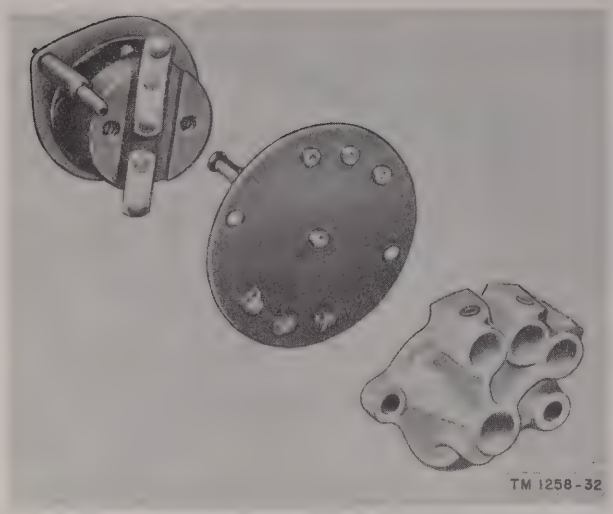


Figure 28. Frequency range selector switch, interior view.

within one-eighth inch of coils L14, L17, and L20 (fig. 25).

(3) Turn the back stop screw into roughly midpoint until it is certain that the attenuator gears cannot become disengaged.

69. Disassembly and Assembly of FREQ. RANGE-MC Switch Cable

a. To remove the cable connected to the FREQ. RANGE-MC switch S5 (fig. 20), proceed as follows:

(1) Remove the knob and the nut which secure the switch to the front panel (fig. 5).

(2) Pull back switch S5 and remove the shield (figs. 20 and 35).

(3) Loosen the setscrew securing the cable to be replaced.

(4) Unsolder the cable at the switch S5 contact and pull the cable free.

b. To replace cable, reverse the above procedure.

70. Disassembly and Assembly of Bolometer

a. To remove RT3, RT4, R127, or R128 which are part of the bolometer assembly (figs. 5 and 29), proceed as follows:

(1) Remove the three screws which secure J1 (fig. 5) and the bottom half of the bolometer (fig. 29) mounting block to the front panel.

(2) Remove the six screws which secure the audio oscillator and deviation indicator assembly TB2 to its mounting brackets (fig. 20).

(3) Swing the assembly out of the way to permit access to the bolometer mounting block.

(4) Remove the block bottom half by removing the three screws which hold it in place (fig. 26). Unsolder and replace the component.

b. Reassemble in reverse order.

71. Disassembly and Assembly of Modulation Switch

a. To remove an inaccessible part on the MODULATION switch assembly (fig. 19), proceed as follows:

(1) Remove the two 2-inch screws which secure this assembly to the power chassis (fig. 36).

(2) Remove the knob from S2 and the two adjacent screws which hold the assembly to the front panel.

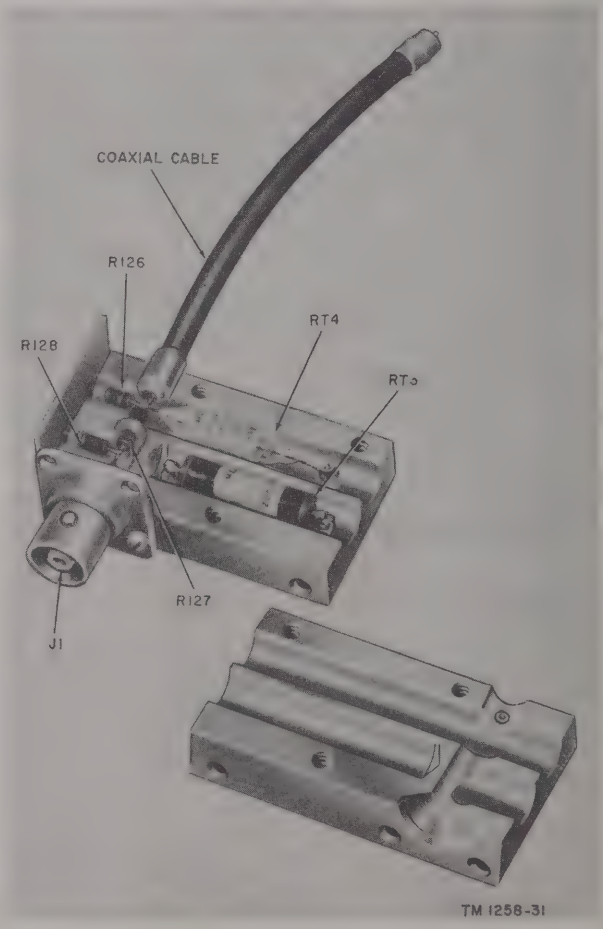


Figure 29. Bolometer assembly, interior view.

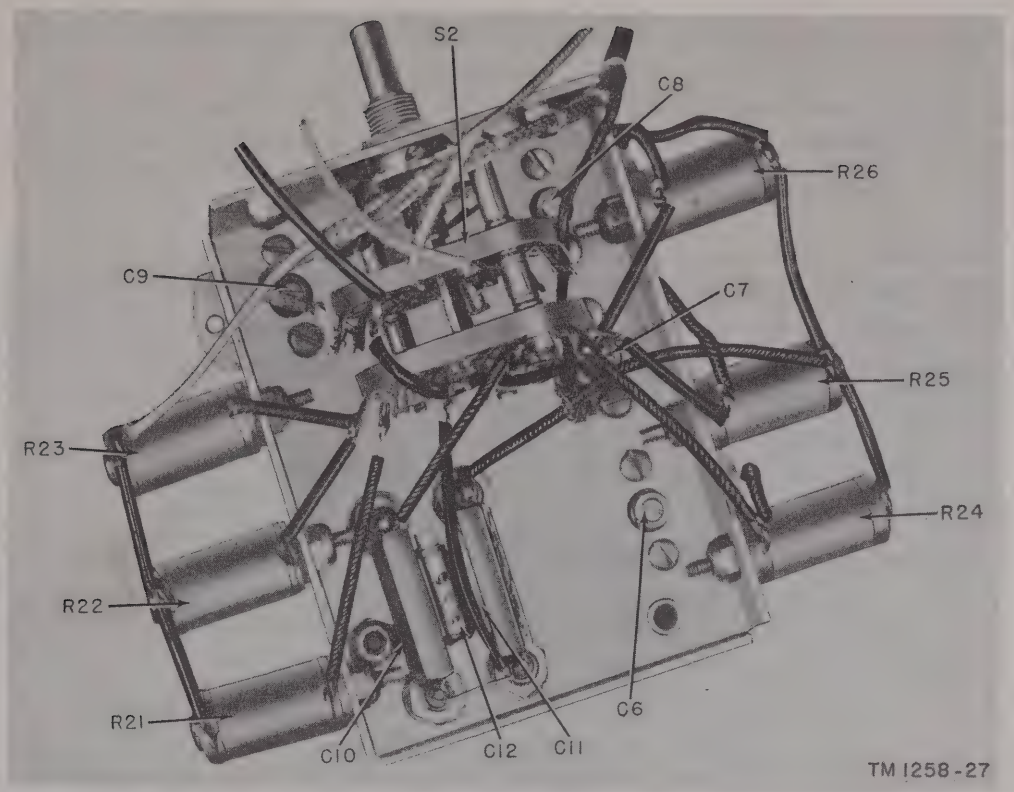


Figure 30. Modulation switch assembly, top view.

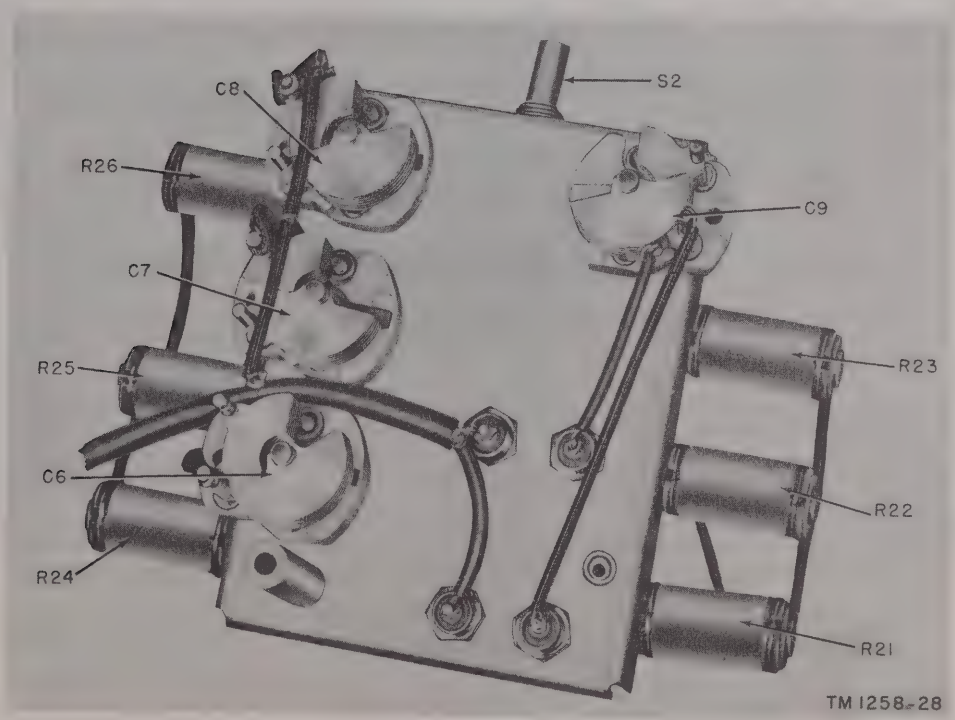


Figure 31. Modulation switch assembly, bottom view.

(3) Swing the assembly clear of the front panel.

(4) Unsolder the leads from the part (figs. 30 and 31). Remove and replace the part.

b. To replace the modulation switch assembly, reverse the above procedure.

72. Disassembly and Assembly of DEV MULT Switch Assembly

a. To remove an inaccessible part on the DEV MULT switch assembly (fig. 19), proceed as follows:

(1) Pull off the knob from the lever of S1.

(2) Remove the two screws which secure this assembly to the front panel.

(3) Swing the assembly clear of the front panel.

(4) Unsolder the leads; remove and replace the part (fig. 32).

b. To replace the DEV MULT switch assembly, reverse the above procedure.

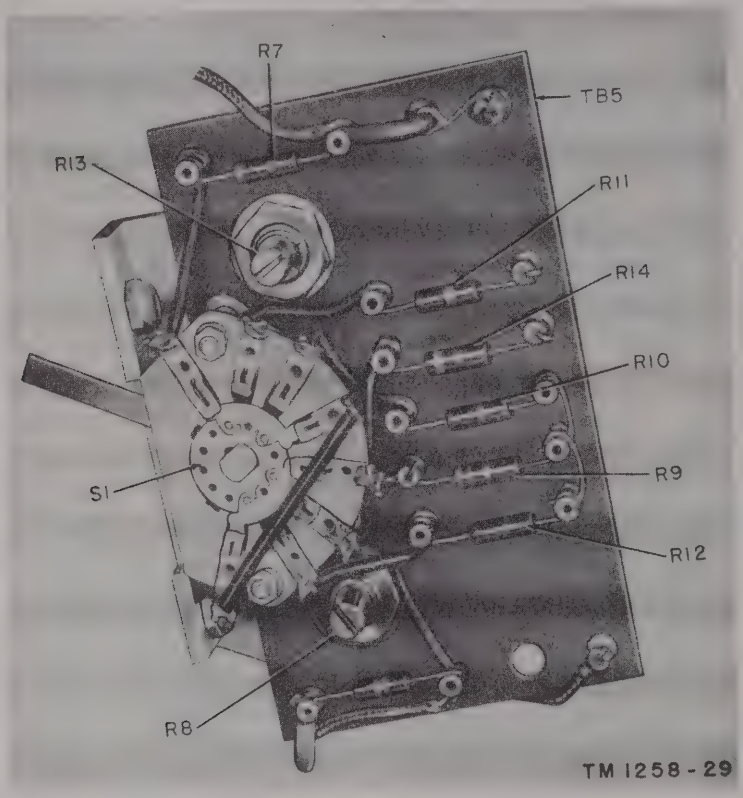


Figure 32. Deviation multiplier switch assembly.

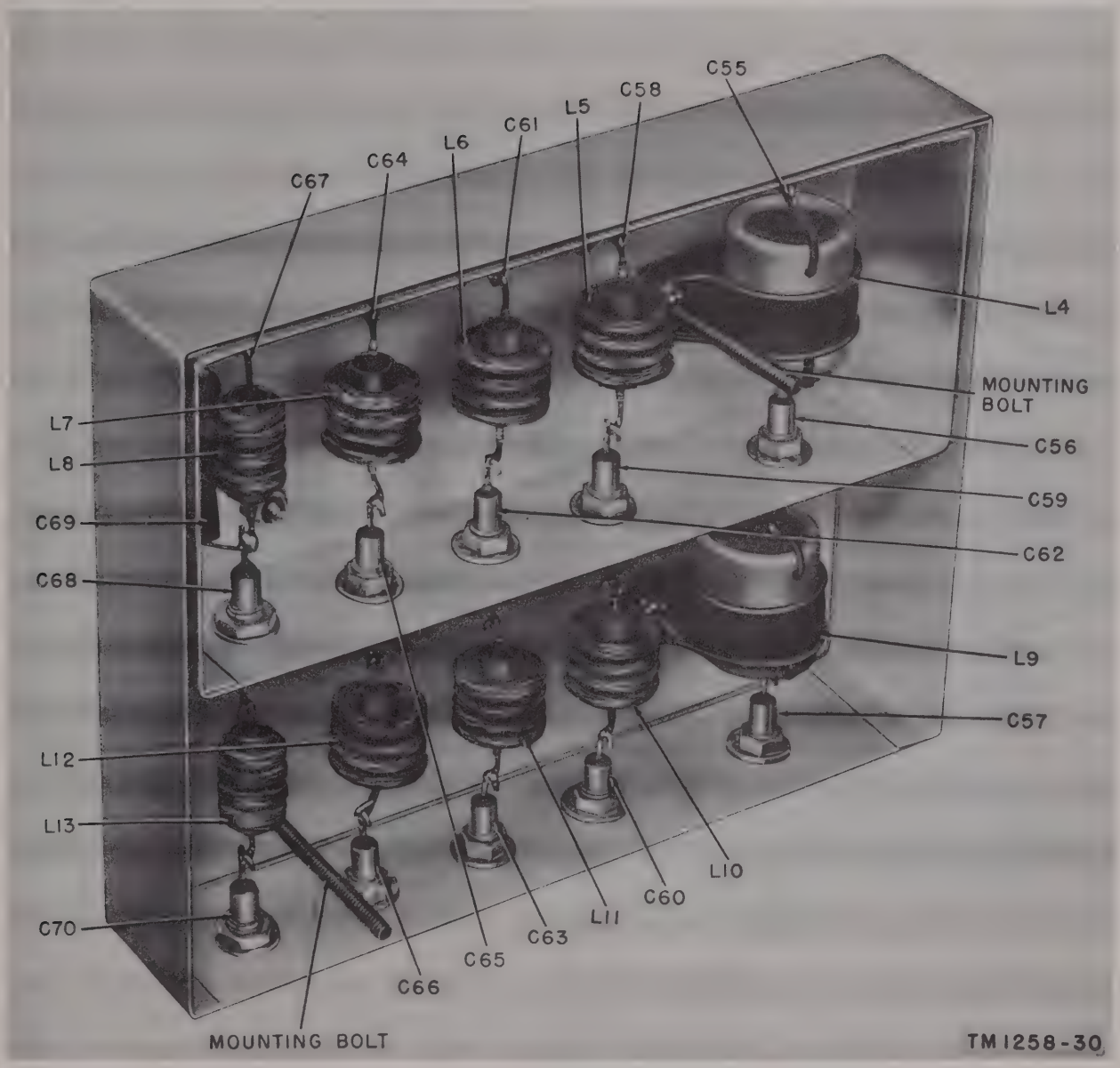


Figure 33. Filter assembly, interior view.

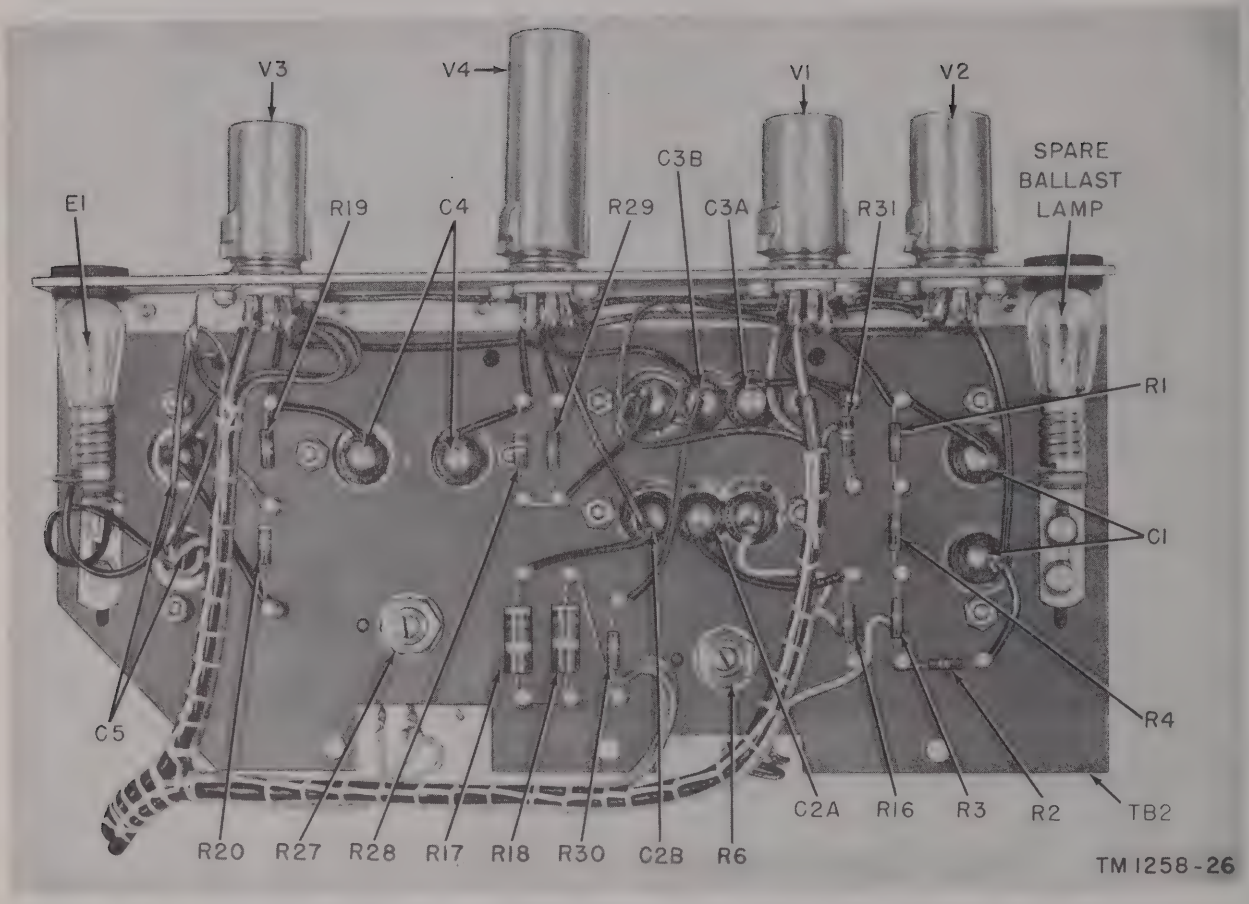


Figure 34. Audio oscillator and deviation indicator assembly, bottom view.

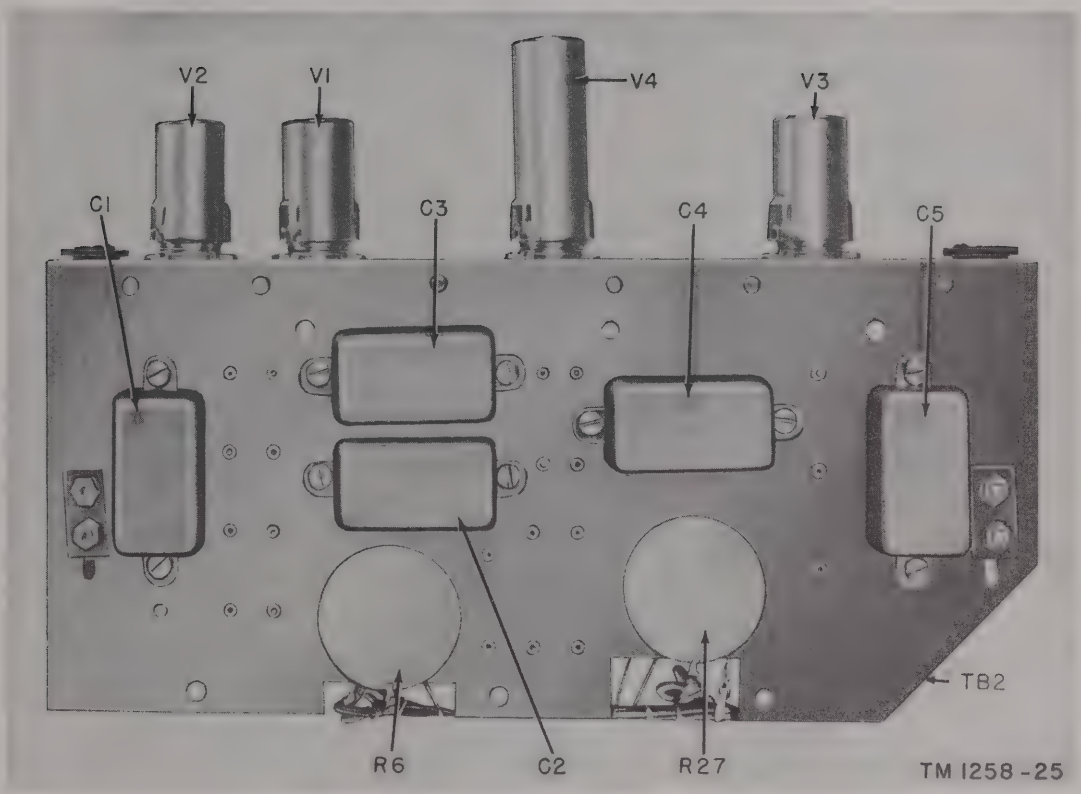


Figure 35. Audio oscillator and deviation indicator assembly, top view.

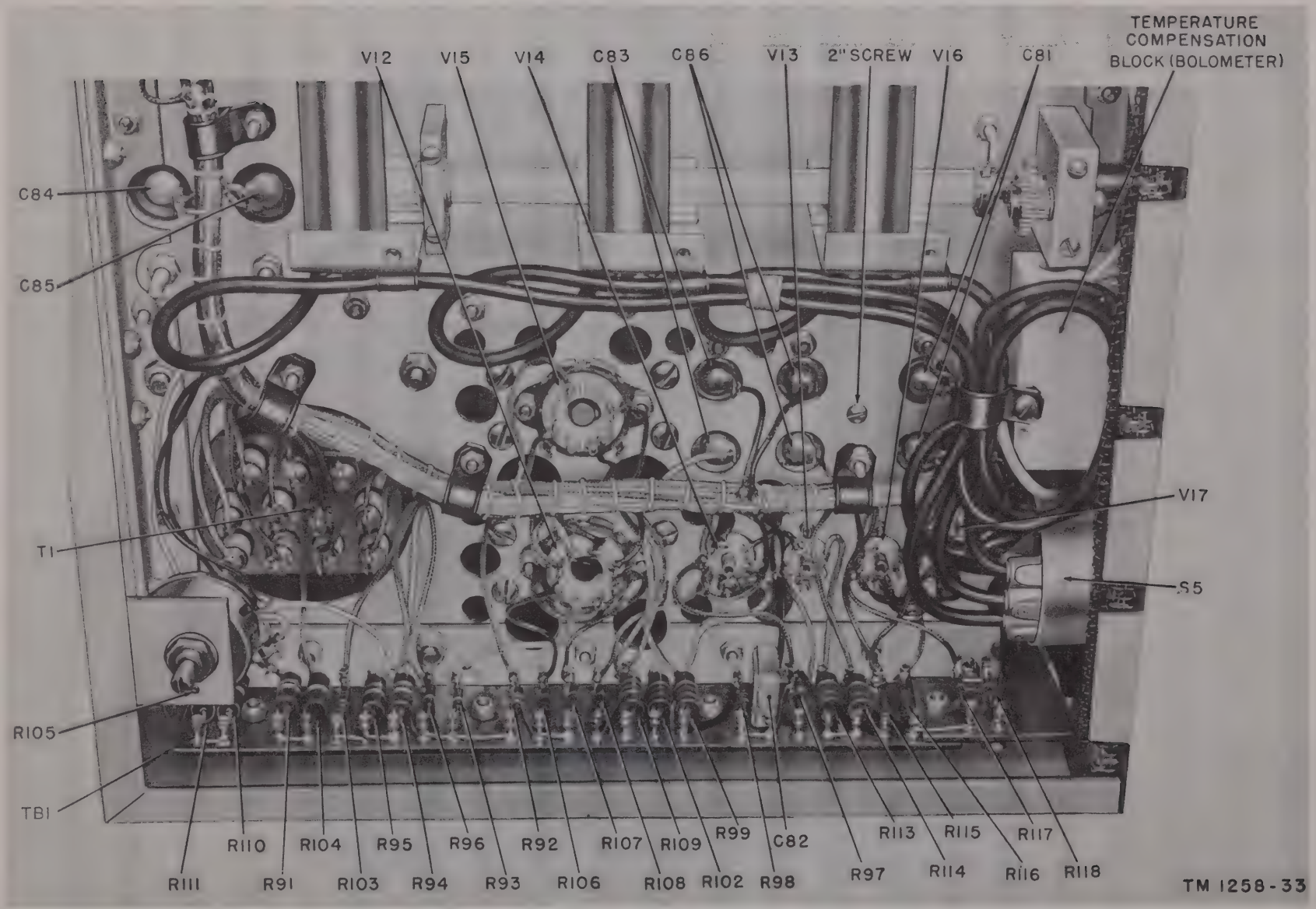


Figure 36. Power supply section, bottom view.

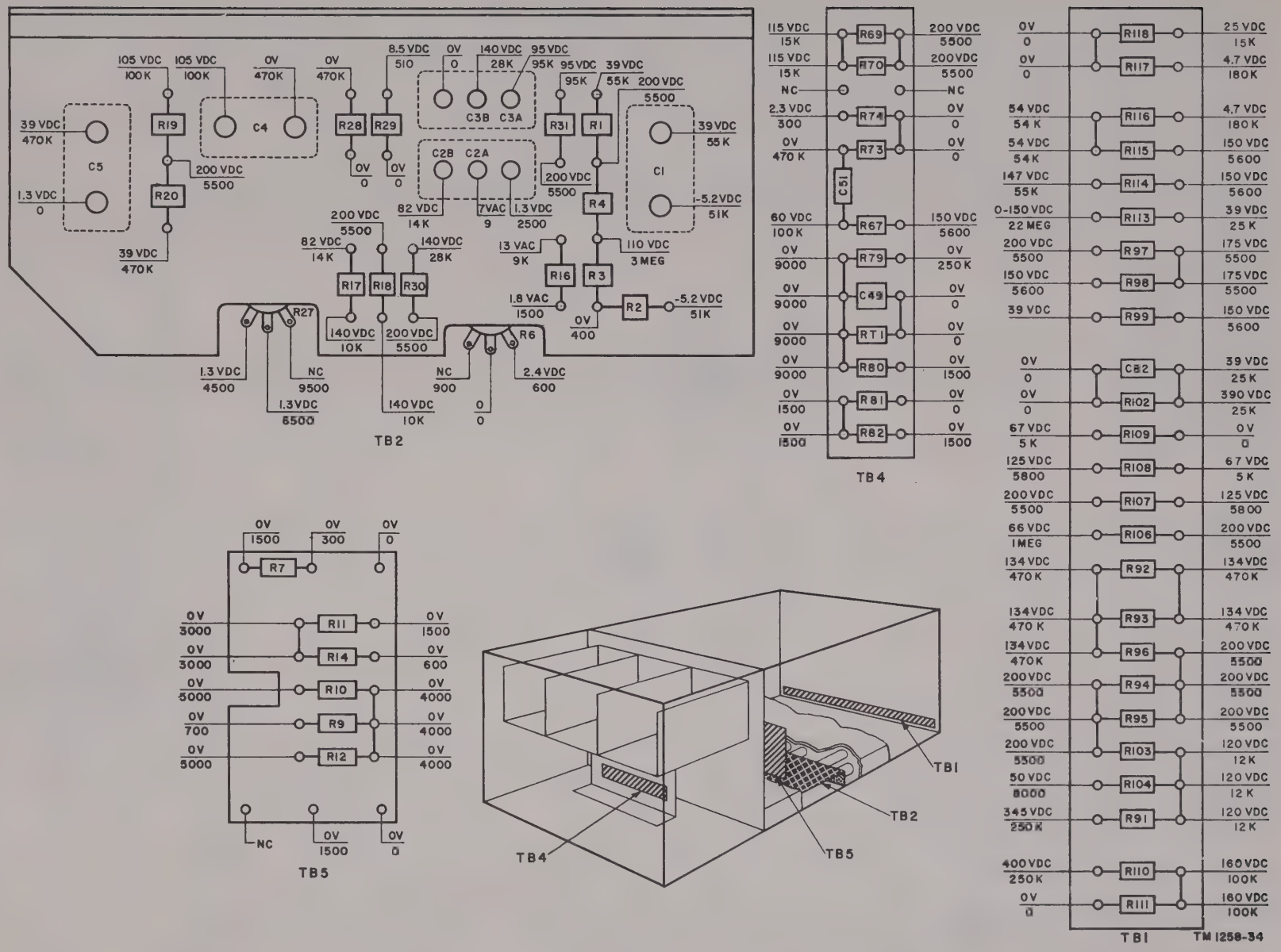
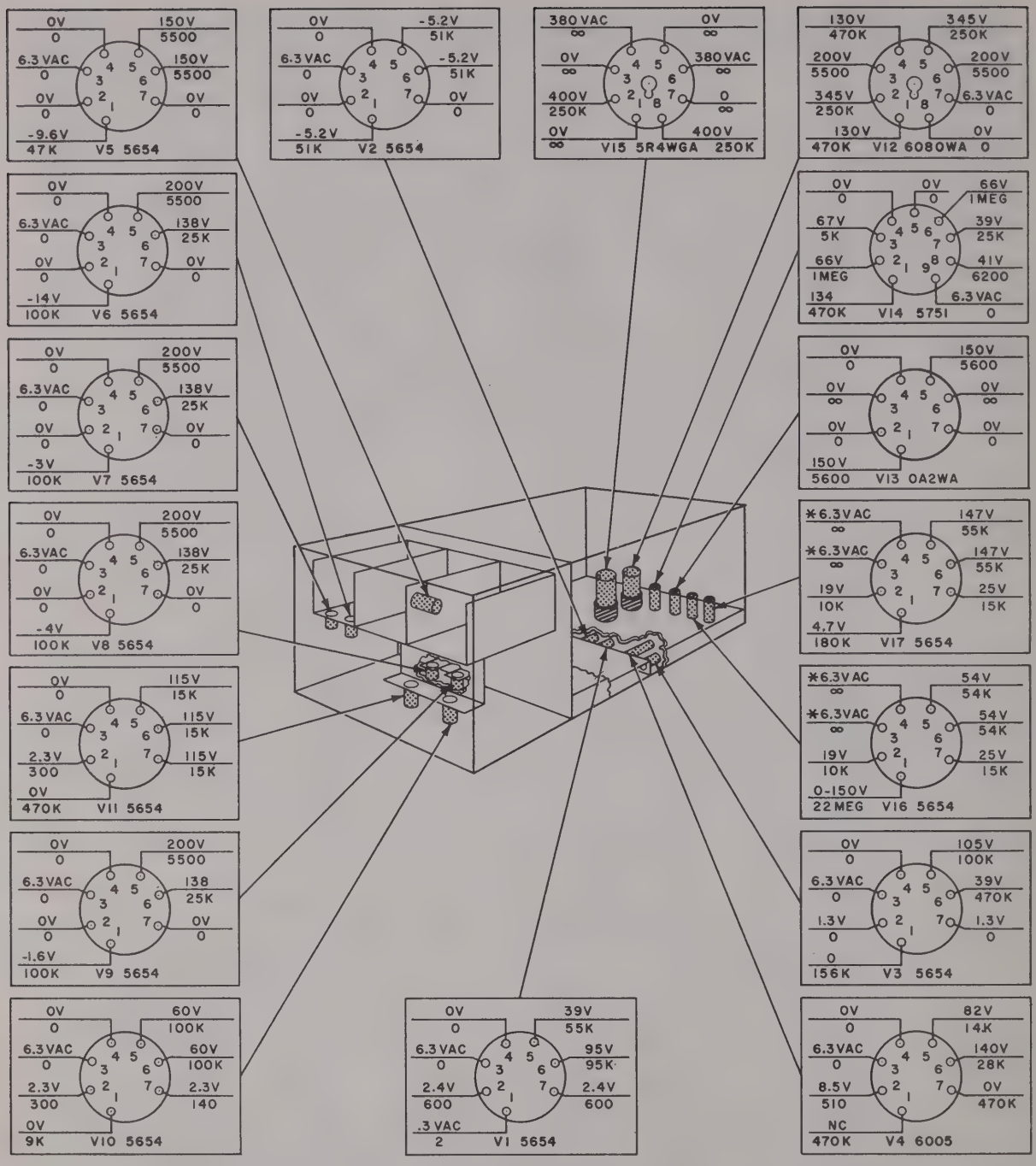


Figure 37. Voltage, resistance, and parts location of terminal boards.



NOTES:

1. ALL DC VOLTAGE TO GROUND MEASUREMENTS ARE MADE WITH A 20,000 OHMS-PER-VOLT METER.
2. ALL AC VOLTAGE TO GROUND MEASUREMENTS ARE MADE WITH A 1,000 OHMS-PER-VOLT METER.
3. CONTROLS SET FOR NORMAL OPERATIONS.
4. 1,000 CPS INTERNAL MODULATION.
5. RESISTANCE TO GROUND MEASUREMENTS MADE WITH POWER SWITCH OFF.
6. NC INDICATES NO CONNECTION.
7. ∞ INDICATES VERY HIGH (GREATER THAN 5 MEGOHMS) RESISTANCE ON METER.
8. * 6.3 VOLTS FOR FILAMENTS READ BETWEEN PINS 3 AND 4.

TM 1258-35

Figure 38. Tube-socket voltage and resistance diagram.

73. Test Equipment Required for Alinement

a. Rf Frequency Meter. The output frequencies to be measured are in the range of 50 to 400 megacycles. Alternate use of Frequency Meters TS–174/U and TS–175/U, or equivalents, will provide full range coverage.

b. Dc Multimeter. A dc voltmeter is needed to check and adjust the dc voltage (+200 volts). It may also be necessary to measure reactor L2 primary current (approx. 10 milliamperes (ma)). Multimeter TS–352/U, or equivalent, will perform both functions.

c. Audio Oscillator. Signal Generator SG–71/FCC, or equivalent, is used in completing the rf distortion test setup.

d. Audio-Frequency Meter. Frequency Meter FR–67/U, or equivalent, is required for accurately measuring the audio-oscillator operating frequencies of 1,000 cps, 1,600 cps, and 20,000 cps.

e. Audio Distortion Indicator. Distortion measurement at the audio oscillator is required in alinement procedures. Use Spectrum Analyzer TS–723/U, or equivalent.

f. Rf Distortion Indicator. A reliable low-distortion fm receiver, in conjunction with Spectrum Analyzer TS–723/U, will serve to indicate rf distortion within Signal Generator SG–3/U.

g. Coil Alinement Tool. Tuning wand S/N 6 R 38490, or equivalent, must be used in predetermining coil forming, when adjusting the stationary rf coils.

h. Rf Deviation Indicator. The rf deviation must be measured during the alinement procedures. Use Panoramic Indicator IP–173/U, or equivalent.

i. Rf Output Level Indicator. Barretter bridge model 202B, or equivalent, is used as a standard for measuring and adjusting output level.

74. Alinement Procedures

a. When any critical circuit in the signal generator is repaired or altered, an alinement check is required. If a circuit is found to need alinement, follow the procedures described in the following paragraphs. Before starting, remove the outer covers from the signal generator. Refer to figure 39 for alinement points. Allow ½ hour for instrument warmup before making any adjustments. When additional test equipment is used, allow a warmup period for this equipment as prescribed in the appropriate manual.

b. Be careful when altering coil forms during the alinement procedures. In most cases, only a slight change in coil form is required to bring that particular stage into correct alinement. Use a tuning wand (copper at one end, iron at the other) to predetermine the extent and direction of coil forming required.

c. Conduct the test in a shielded inclosure. If a shielded room is not available, make the alinement in an area free from stray rf and electrical disturbances.

d. To assure stable functioning of all test equipment used, maintain a regulated line voltage to the test area.

e. Follow the alinement procedures in sequence.

75. Adjusting Regulated Supply

Adjustment of the dc voltage (200 volts) is required before any other alinement is started.

a. Turn the POWER switch to ON.

b. Connect a dc voltmeter (0- to 300-volt range) between ground and the junction of resistors R94 and R95.

c. Adjust potentiometer R105 (+200 adjust) for a meter reading of 200 volts.

d. Disconnect the voltmeter.

76. Adjusting Rf Oscillator

The rf oscillator supplies the base frequency for all output ranges of the signal generator. Therefore, it is important to use an accurate frequency measuring device when adjusting the rf oscillator. Be sure that the instrument has had a ½-hour warmup period before beginning these adjustments.

a. Connect the R. F. OUTPUT jack to the external frequency meter. Use Frequency Meters TS–174/U and TS–175/U or their equivalents.

b. Set the MODULATION selector to the OFF position.

c. Place the FREQ. RANGE-MC selector in the 50–100 mc position.

d. Rotate the TUNING knob to indicate 50 megacycles on the FREQ. IN MEGACYCLES scale.

e. Increase the OUTPUT control knob for a reading at the external frequency meter, which

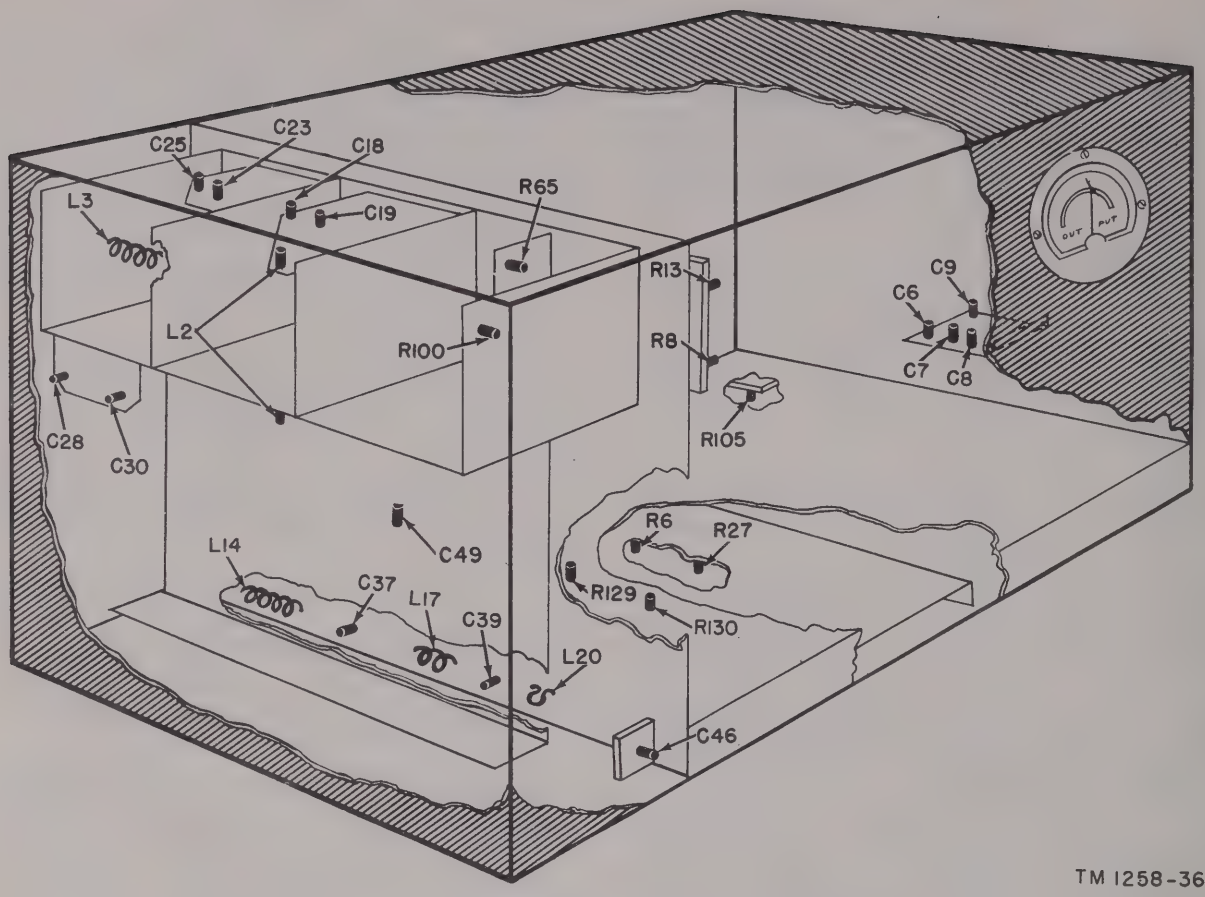


Figure 39. Signal Generator SG–3/U, alinement points.

should be set to 50 mc. If a reading is not obtained, vary the frequency meter range above and below 50 mc to determine the output frequency.

f. Vary the two slugs of coil L2 in equal increments to obtain a 50-mc reading at the frequency meter.

g. Rotate the TUNING knob to 100 mc.

h. Vary capacitors C18 and C19 equally to obtain a 100-mc reading at the frequency meter.

i. Repeat procedure outlined in *c* through *g* above until proper tracking of the frequency tuning dial is obtained.

77. Alining First Doubler

a. Connect a dc voltmeter (0- to 200-volt range) between pin 6 of V7 and ground. A reading of approximately 135 volts dc will be obtained.

b. Tune the signal generator to 50 mc.

c. Form coil L3 for a maximum voltage reading on the dc voltmeter.

d. Rotate the tuning dial to 100 mc.

e. Vary capacitors C23 and C25 equally for a maximum reading on the dc voltmeter.

f. Repeat procedure outlined in *b* through *e* above to obtain the highest possible voltmeter reading.

78. Alining Rf Amplifier

Note. Throughout the alinement of this stage and the following doubler stages, output indicator M2 of the signal generator is used. Adjustments should be made for maximum output indication, backing down on the attenuator coupling as necessary to keep the output meter needle close to center scale.

a. Tune the signal generator to 50 mc.

b. Form coil L14 for maximum output indication.

c. Tune the signal generator to 100 mc.

d. Adjust C28 and C30 equally for maximum output reading.

e. Repeat procedure outlined in *a* through *d* above to obtain the highest reading on the output meter.

79. Alining Second Doubler

a. Place the FREQ. RANGE–MC selector in the 100–200 mc position.

b. Tune the signal generator to 100 mc.

c. Form coil L17 to produce a maximum reading on the output meter.

d. Tune the signal generator to 200 mc.

e. Vary capacitors C37 and C39 equally for a maximum output reading.

f. Repeat procedure outlined in *b* through *e* above to obtain the highest output readings.

80. Alining Third Doubler

a. Set the FREQ. RANGE–MC selector to the 200–400 mc position.

b. Tune the signal generator to 200 mc.

c. Form coil L20 to produce a maximum reading on the output meter.

d. Tune the signal generator to 400 mc.

e. Vary the front panel control 200–400 MC TRIMMER for maximum output reading.

f. Repeat procedure outlined in *b* through *e* above to obtain a maximum output reading.

81. Calibrating Output Signal Level

a. Barretter bridge model 202B and fixed attenuator S/N 2Z9944–16, or their equivalents, are required for output calibration.

b. Connect the R. F. OUTPUT to the fixed attenuator, using output cable W2, terminated in Adaptor Connector UG–564/U. Connect the pad directly to the Barretter bridge.

c. Adjust the OUTPUT control of the signal generator to produce a reading of 50 millivolts (50,000 microvolts) on the Barretter bridge.

Note. This corresponds to a generator output voltage of 100,000 microvolts, since a 2:1 voltage loss ratio is introduced by the fixed attenuator.

d. Adjust output calibration potentiometer R130 (fig. 19) to bring the pointer of OUTPUT meter M2 to center scale (SET TO LINE).

82. Adjusting Output Temperature Compensation

a. Connect the equipment as directed in paragraphs 81*a*, *b*, and *c*.

b. Set the OUTPUT control to obtain a 100,000-microvolt reading at center scale (par. 81). Maintain the 50,000-microvolt reading at the Barretter bridge throughout the following adjustments.

c. Apply heat (soldering iron) to the bolometer block.

d. If the OUTPUT meter needle drifts away from the center scale reading, note the deflection.

e. Remove the heating device, and allow the block to cool.

f. Adjust R129 and R130 to new positions for center scale indication with 100,000 microvolts output. Note the direction of adjustment.

g. Repeat the procedures given in *c*, *d*, and *e* above. If deflection increases, readjust R129 and R130 in the opposite direction from that noted in *f* above.

h. Repeat procedure outlined in *g* above until the deflection is negligible.

83. Adjusting Audio-freqency Oscillator

a. Connect a precision audio-frequency (af) indicator between pin 1 of V1 and ground. Use Frequency Meter 67/U or its equivalent.

b. Rotate the DEVIATION control to obtain a full-scale reading on KILOCYCLES DEVIATION meter M1.

c. Set the MODULATION selector to 1000∼.

d. Adjust capacitor C8 for a 1,000-cps indication at the af indicator.

e. Set the MODULATION selector to 1600∼.

f. Adjust capacitor C7 for a 1,600-cps reading at the af indicator.

g. Set the MODULATION selector to 20KC.

h. Adjust capacitor C6 for a 20,000-cps reading at the af indicator.

Note. If any of the audio frequencies cannot be obtained, adjust capacitor C9. This will shift the overall af range up or down in accordance with the adjustment. After adjusting C9, capacitors C6, C7, and C8 must be readjusted (*c* through *h* above).

i. Disconnect the af indicator.

j. Connect a precision audio distortion indicator between pin 1 of V1 and ground. Use Spectrum Analyzer TS–723/U or its equivalent.

k. Adjust potentiometer R27 for a distortion reading of less than .2 per cent at 1,000, 1,600, and 20,000 cycles per second.

l. Disconnect the distortion meter.

84. Adjusting Deviation Compensation and Deviation Calibration

a. Set R65 to approximately midrange.

b. Tune the signal generator to 100 mc on the 50–100 mc band.

c. Set the MODULATION selector to 20KC and the DEV MULT switch to X10, rotate the DEVIATION control fully counterclockwise.

d. Connect the signal generator to the input of Panoramic Indicator IP–173/U and obtain an indication of the carrier on the screen.

e. Rotate the DEVIATION control until the carrier goes through the *second* null. (This represents a 110-kc deviation.) Note the reading of the KILOCYCLES DEVIATION meter.

f. Tune the signal generator to 50 mc and repeat the procedure given in *c*, *d*, and *e* above.

g. If the new reading of the KILOCYCLES DEVIATION meter is more than 5 percent different from the previous reading, readjust R65 slightly, noting the direction of rotation.

h. Repeat the procedure given in *b* through *f* above.

i. If the difference between the 50- and 100-mc readings is greater than previously, readjust R65 in the opposite direction.

j. Repeat procedure given in *b* through *g* above until the difference between the 50- and 100-mc readings is less than 5 percent.

k. Readjust DEV CAL potentiometer R6 until the KILOCYCLES DEVIATION meter indicates 110 kc with the carrier in the second null.

l. Disconnect the panoramic indicator.

85. Calibrating Deviation Multiplier

a. Connect an accurate vacuum-tube voltmeter (Electronic Multimeter TS–505/U) to the green lead connecting S1 to C70 or to C67. When measuring unknown voltages, select the highest scale to protect the meter.

b. Set the MODULATION selector to 1000 ~.

c. Set the DEV MULT switch to the X10 position.

d. Set the DEVIATION control to produce a full-scale reading at the external voltmeter, on any convenient scale.

e. Set the DEV MULT switch to the X5 position.

f. Adjust X5 ADJ potentiometer R8 to produce a reading of ½ scale at the external voltmeter.

g. Set the DEV MULT switch to X1 scale.

h. Adjust X1 ADJ potentiometer R13 to produce a reading of 1/10 full scale at the external voltmeter.

i. Disconnect the external voltmeter.

86. Adjustment of Bias Potentiometer for Minimum RF Distortion

Warning: Adjust the bias potentiometer only when L1 has been replaced. When bias potentiometer R100 is adjusted it is necessary to repeat the steps in paragraph 84.

a. Connect the following equipment to the R. F. OUTPUT jack of Signal Generator SG–3/U (fig. 40).

(1) Radio Receiver R–274/FRR.
(2) Spectrum Analyzer TS–723/U.

b. Adjust Signal Generator SG–3/U as follows:

(1) Set the MODULATION selector to 1000 ~.
(2) Place the FREQ. RANGE-MC switch in the 100–200 mc position. Adjust the TUNING control until the FREQ. IN MEGACYCLES dial indicates 50 mc.
(3) Set the DEVIATION control to produce a full-scale reading on the KILOCYCLES DEVIATION meter.
(4) Adjust bias potentiometer R100 for minimum second harmonic distortion.

c. Recheck the accuracy of the frequency, deviation compensation, and deviation calibration adjustment (par. 84).

Note. In an emergency, if rf distortion measuring equipment is not available, a dc milliammeter may be used for indicating the approximate correct setting of R100. Unsolder either lead of R100 and insert a dc milliammeter (0- to 20-ma range) across the open connection. Adjust R100 to produce a meter reading of 9 ma. Disconnect the meter and resolder the lead. Recheck as in *c* above.

87. Deviation Frequency Compensation

Warning: Readjust deviation frequency compensator C49 only when L1 has been replaced.

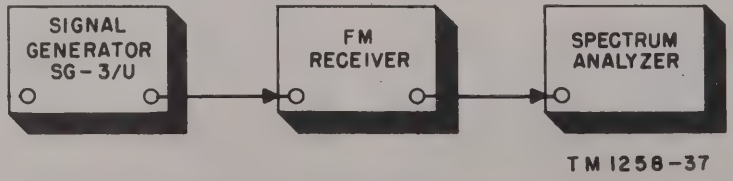


Figure 40. Rf distortion test setup.

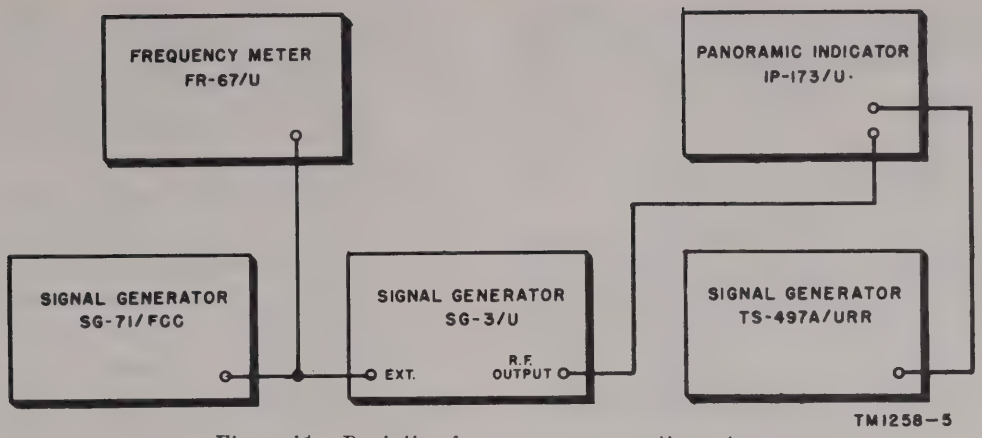


Figure 41. Deviation frequency compensation setup.

a. Connect the following items of equipment as shown in figure 41:

(1) Signal Generator SG–3/U.
(2) Signal Generator SG–71/FCC.
(3) Signal Generator TS–497A/URR.
(4) Frequency Meter FR–67/U.
(5) Panoramic Indicator IP–173/U.

b. Adjust Signal Generator SG–3/U as follows:

(1) Set the MODULATION switch to EXT.
(2) Place the FREQ. RANGE-MC switch to the 100–200 mc position.
(3) Set the DEV MULT switch to X10.
(4) Set the DEVIATION control fully counterclockwise.
(5) Adjust the TUNING control until the FREQ. IN MEGACYCLES dial indicates 100.

c. Adjust Signal Generator TS–497A/URR to an unmodulated frequency which is exactly 5 mc above or below the frequency of Signal Generator SG–3/U.

d. Adjust Panoramic Indicator IP–173/U and Signal Generator TS–497A/URR until a carrier pip is observed at the center of the indicator screen.

e. Adjust Signal Generator SG–71/FCC to a frequency of 70.7 kc. Frequency Meter FR–67/U is used to check the accuracy of this signal.

f. Proceed to check the deviation frequency compensation in Signal Generator SG–3/U as follows:

(1) Turn the DEVIATION control clockwise until the first carrier null is observed on the panoramic indicator screen.
(2) Read and note the deviation as indicated by the KILOCYCLES DEVIATION meter.

g. Repeat procedure given in *f* above; use the following external modulating frequencies:

(1) 30.8 kc and second null.
(2) 19.65 kc and third null.
(3) 11.4 kc and fifth null.
(4) 5.55 kc and tenth null.

h. If any of the readings obtained vary more than 5 percent from the others, adjust C49 as follows: If the reading obtained at 70.7 kc is higher than the average, decrease C49; if the reading is lower, increase C49.

i. Repeat the procedure given in *b* through *h* above with Signal Generator SG–3/U tuned to 200 mc.

Section IV. FINAL TESTING

88. General

This section is a guide to aid in determining the quality of a repaired Signal Generator AN/URM–70. The minimum test requirements, outlined in paragraphs 89 through 94, may be checked by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment must meet these requirements for satisfactory operation.

89. Test Equipment Required for Final Testing

The instruments needed for testing the signal generator are listed in paragraph 55.

90. Test Conditions

a. A ½- to 1-hour warmup period should be allowed before final testing is begun.

b. Line voltage to the test setup must be 115 volts, 50 to 60 cycles.

c. Test indications beyond allowable limits will require realinement or repair of the stage under test. A complete final test must be repeated following any repair or alinement.

91. Output Tests

a. Output Frequency Test.

(1) Connect an external frequency measuring device to the R. F. OUTPUT jack. Use Frequency Meter TS–174B/U or Frequency Meter TS–175B/U or their equivalents.

(2) Set the FREQ. RANGE-MC selector to the 50–100 mc position.

(3) Set the MODULATION selector to OFF.

(4) Tune the signal generator to 50 mc, 75 mc, and 100 mc. The respective indications at the external frequency meter should be within ±1 percent of the FREQ. IN MEGACYCLES dial setting.

b. Rf Output Level and Calibration Test.

(1) Connect Barretter bridge model 202B to the R. F. OUTPUT jack through a fixed attenuator SN2Z394.85. The Barretter bridge will indicate 50,000 microvolts (uv) when the signal generator output is 100,000 uv.

(2) Set the FREQ. RANGE-MC selector to the 50–100 mc position, and the MODULATION selector to OFF.

(3) Tune the signal generator to 50 mc.

(4) Rotate the OUTPUT control to bring the pointer of OUTPUT meter M2 to center scale (SET TO LINE).

(5) The output voltage of the signal generator must be 100,000 microvolts ±2 db.

(6) Repeat procedure outlined in (4) and (5) above at frequencies of—

(*a*) 75 and 100 mc on the 50- to 100-mc range.

(*b*) 100, 150, and 200 mc on the 100- to 200-mc range.

(*c*) 200, 300, and 400 mc on the 200- to 400-mc range. (Use 200–400MC TRIMMER.)

92. Audio-Oscillator Tests

a. Audio-Oscillator Frequency Test.

(1) Remove the signal generator instrument cover.

(2) Connect an audio-frequency indicating device between pin 1 of V1 and ground. Use Frequency Meter FR–67/U or its equivalent.

(3) Turn the DEVIATION control fully clockwise.

(4) Rotate the MODULATION selector to 1000∼, 1600∼, and 20KC.

(5) The audio-frequency meter should indicate 1,000 cps, 1,600 cps, and 20,000 cps, accurate to ±1 percent.

b. Audio-Oscillator Distortion Test.

(1) Connect an audio distortion indicating device between pin 1 of V1 and ground. Use Spectrum Analyzer TS–723/U or its equivalent.

(2) Rotate the DEVIATION control to produce a full-scale reading on meter M1.

(3) Set the MODULATION selector to 1000∼, 1600∼, and 20KC.

(4) The indication at the distortion meter should not exceed .2 percent distortion at each position of the MODULATION selector.

93. Deviation Tests

a. Deviation Multiplier Test.

(1) Connect Electronic Multimeter TS–505/U to the green lead connecting S1 to C70 or to C67. When measuring unknowr voltages, select the highest scale to protect the meter.

(2) Set the MODULATION selector to 1000∼.

(3) Set the DEV MULT switch to the X10 position.

(4) Set the DEVIATION control to produce a full-scale reading at the external voltmeter, on any convenient scale.

(5) Set the DEV MULT switch to the X5 position.

(6) The external voltmeter should indicate 1/2 scale ±5 percent.

(7) Set the DEV MULT switch to the X1 position.

(8) The external voltmeter should indicate 1/10 full scale ±5 percent.

(9) Replace the instrument cover.

b. RF Deviation Test.

(1) Tune the signal generator to 100 mc on the 50–100 mc band.

(2) Set the MODULATION selector to 20KC and the DEV MULT switch to X10, rotate the DEVIATION control fully counterclockwise.
(3) Connect the signal generator to the input of the panoramic indicator and obtain an indication of the carrier on the screen. Use Panoramic Indicator IP–173/U or its equivalent.
(4) Rotate the DEVIATION control until the carrier goes through the second null.
(5) The KILOCYCLES DEVIATION meter should indicate 110 kc ±25 percent.

94. Rf Distortion Test

a. Connect Radio Receiver R–274/URR to the R. F. OUTPUT jack of Signal Generator SG–3/U. Spectrum Analyzer TS–723/U is connected to the audio output of the radio receiver (fig. 40).

b. Adjust Signal Generator SG–3/U as follows:
(1) Place the MODULATION selector in the 1000 ~ position.
(2) Place the DEV MULT switch in the X5 position.
(3) Adjust the DEVIATION control until the KILOCYCLES DEVIATION meter indicates 75 kc.
(4) Place the FREQ. RANGE-MC switch in the 50–100 mc position.
(5) Adjust the TUNING control until the FREQ. IN MEGACYCLES dial indicates 50 mc.

c. Adjust Radio Receiver R–274/URR for fm reception and tune it to 50 mc. The radio receiver acts as a detector in this test.

d. Measure the harmonic distortion on Spectrum Analyzer TS–723/U. The total harmonic distortion indicated by the spectrum analyzer should not exceed .5 percent.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

95. Disassembly

Use the following procedure to prepare Signal Generator AN/URM–70 for shipment and storage.

a. Disconnect the cables and adapters and store them in their proper location.

b. See that all spare fuses, tubes, and panel lamps are securely in place and will not shake loose.

c. Place the power cord plug in the unmarked receptacle on the front panel.

d. Place the cover on the transit case and snap the fasteners.

96. Field Repackaging Data

a. Materials Required. The following materials are required for packaging Signal Generator AN/URM–70.

Material	Quantity
Waterproof barrier material	16 square feet.
Single-faced corrugated paper	18 square feet
Pressure-sensitive tape	10 feet
Gummed paper tape	9 feet
Lumber	18 board-feet

b. Box Size. The dimensions of the shipping container required for the signal generator are given in the chart below.

Box No.	Height (in.)	Width (in.)	Depth (in.)	Board ft.	Volume (cu. ft.)	Packed weight (lb)
1 of 1	20½	24⅝	19½	18	5. 52	160

97. Repackaging Signal Generator AN/URM–70

Package Signal Generator AN/URM–70 as follows:

a. Place each manual in a close-fitting bag made of waterproof barrier material. Seal all seams and openings with pressure-sensitive tape.

b. Wrap the signal generator with single-faced corrugated paper.

c. Fasten the wrapping with gummed paper tape.

98. Field Packing and Marking

a. Make a wooden box to fit the packaged signal generator and manuals snugly.

b. Fit the shipping container with a lining of waterproof barrier material. Seal all seams and openings with pressure-sensitive tape.

c. Place the signal generator in the lined shipping container; be sure that the signal generator fits snugly. Add corrugated paper as filler to prevent movement of the generator during shipment.

d. Place the manuals on top of the packed generator and seal the barrier material with pressure-sensitive tape.

e. Place the cover on the shipping container and nail it in place. Strap shipping containers for intertheater movement only.

f. Mark shipping containers in accordance with the requirements of section II, chapter 2, SR 55–720–1.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

99. Authority for Demolition

The demolition procedures outlined in paragraph 100 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only on order of the commander.

100. Methods of Destruction

a. Smash. Smash the controls, tubes, coils, switches, meters, resistors, capacitors, and transformers; use sledges, axes, hammers, crowbars, or other heavy tools.

b. Cut. Cut cords and wiring; use axes or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

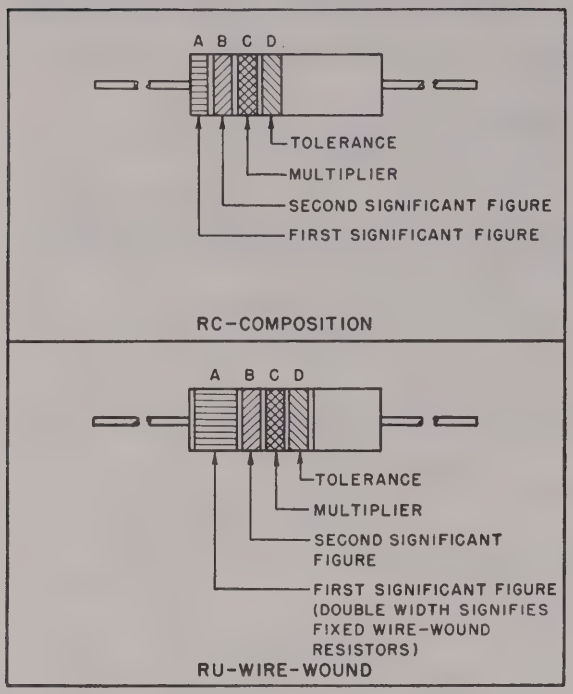
e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

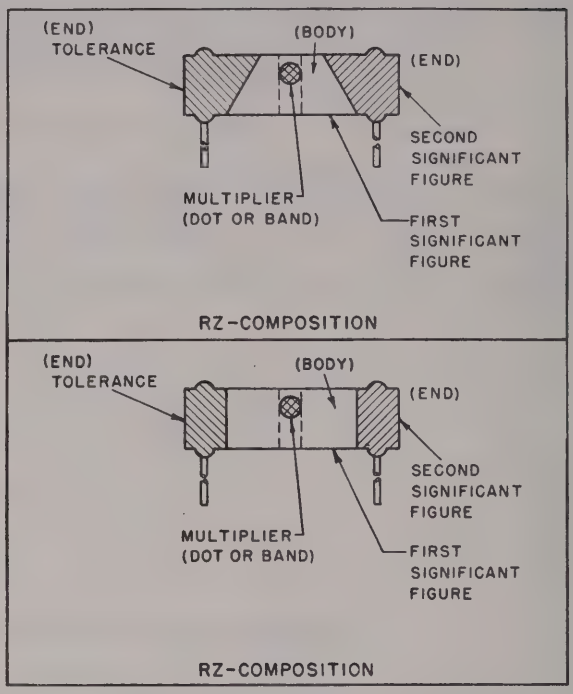
g. Destroy. Destroy everything.

RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

* FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

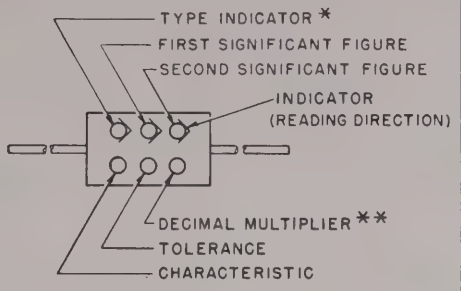
EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

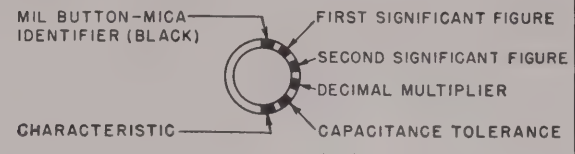
Figure 42. Resistor color code.

CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)

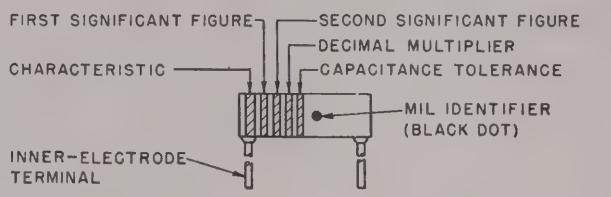


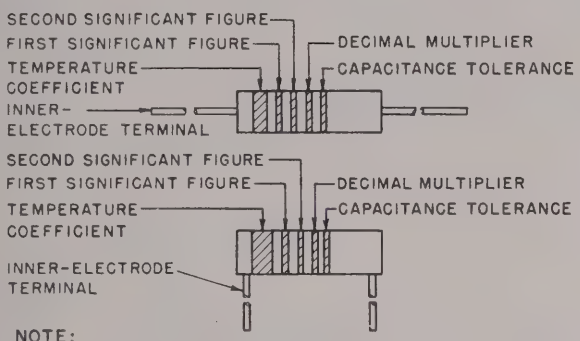
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)



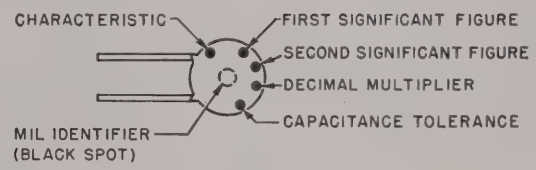
BUTTON-MICA (CB)





NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

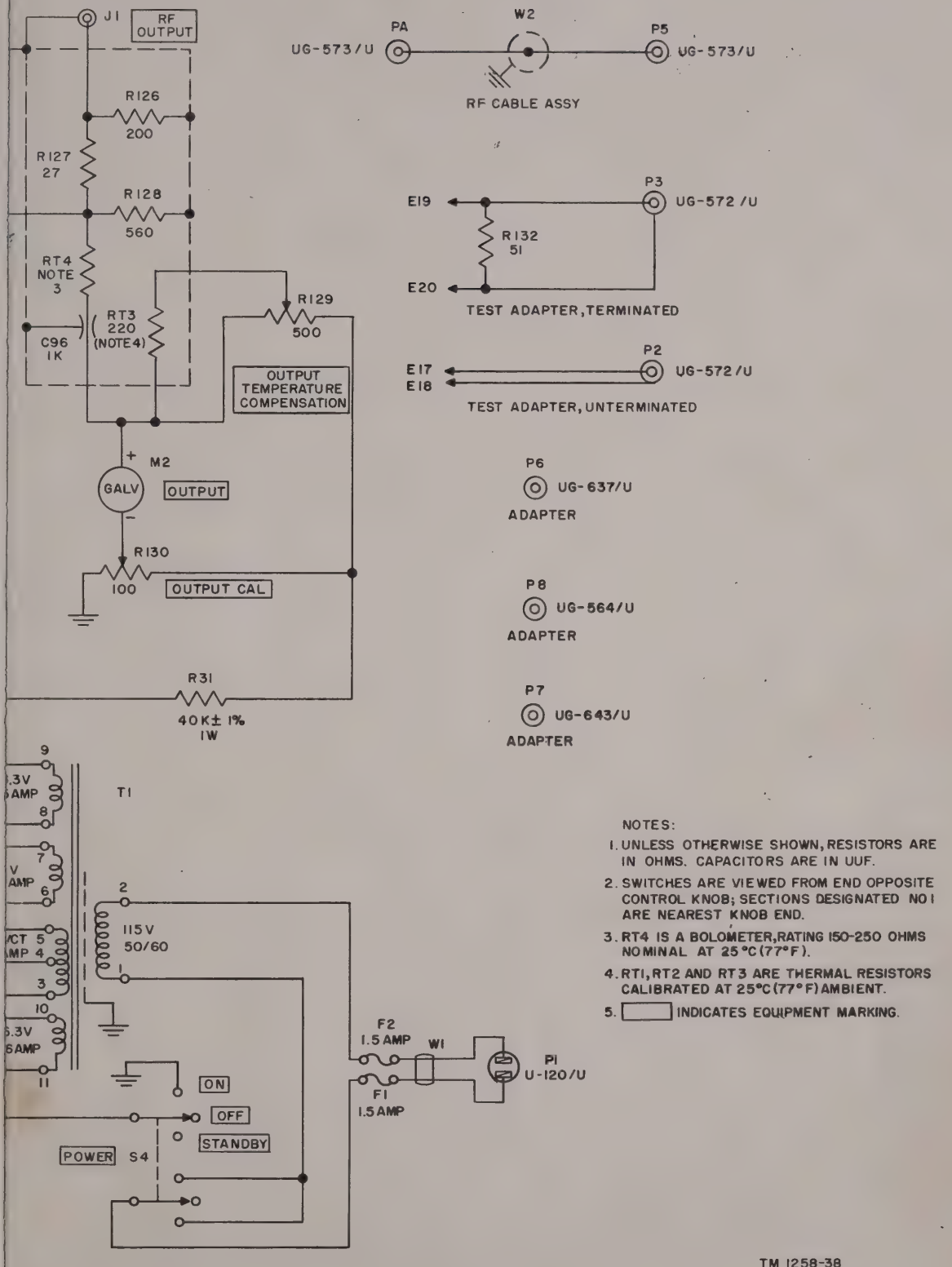
CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

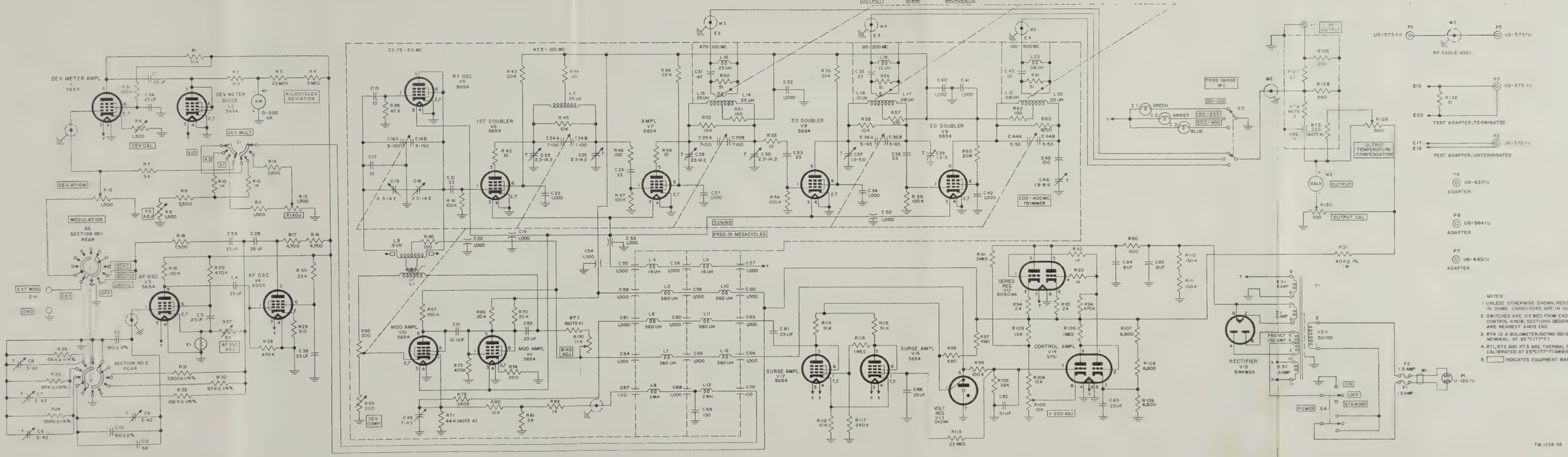
Figure 43. Capacitor color code.



NOTES:

1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS. CAPACITORS ARE IN UUF.
2. SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB; SECTIONS DESIGNATED NO 1 ARE NEAREST KNOB END.
3. RT4 IS A BOLOMETER, RATING 150-250 OHMS NOMINAL AT 25°C (77°F).
4. RT1, RT2 AND RT3 ARE THERMAL RESISTORS CALIBRATED AT 25°C (77°F) AMBIENT.
5. [ ] INDICATES EQUIPMENT MARKING.

TM 1258-38



538193 O - 60 (Face p. 70)

Figure 44. Signal Generator SG-3/U, schematic diagram.

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[AG 413.44 (29 APR 55)]

By order of the Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

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Tec Svc Bd (1)
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OS Base Comd (5)
Log Comd (5)
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Corps (2)
Tng Div (2)
Ft & Cp (2)
Gen & Br Svc Sch (5)
SigC Sch (25)
Gen Depots (2)
SigC Sec, Gen Depots (10)
SigC Depots (20)
POE (2)
OS Sup Agencies (2)
SigC Fld Maint Shops (3)
SigC Lab (5)
Mil Dist (1)
Units organized under following TOE's:
11–7, Sig Co Inf Div (2)
11–16A, Hq & Hq Co, Sig Bn, Corps or Abn Corps (2)
11–57, Armd Sig Co (2)
11–127, Sig Rep Co (2)
11–128A, Sig Depot Co (2)
11–500A (AA through AE), Sig Svc Org (2)
11–557A, Abn Sig Co (2)
11–587A, Sig Base Maint Co (2)
11–592A, Hq & Hq Co, Sig Base Depot (2)
11–597A, Sig Base Depot Co (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

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